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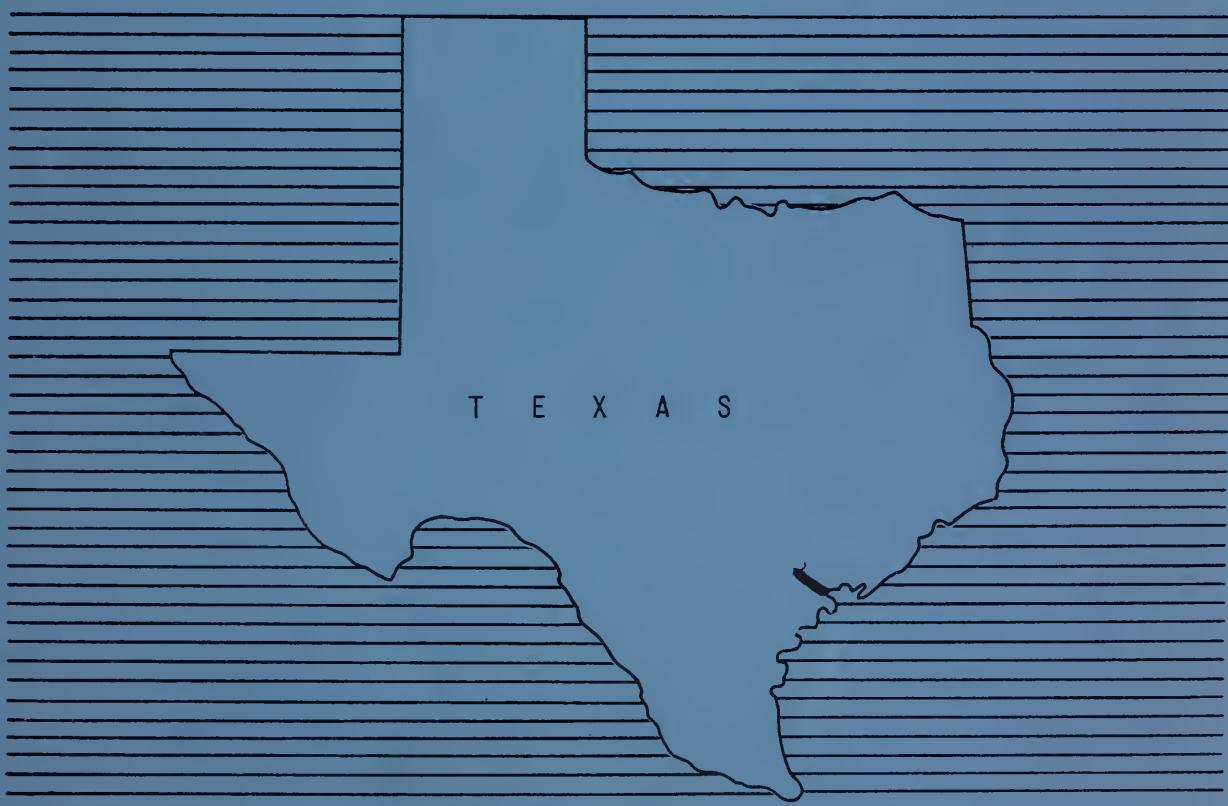
Mr. Hill
Room 2035

WORK PLAN

- FOR WATERSHED PROTECTION, FLOOD PREVENTION,
AND AGRICULTURAL WATER MANAGEMENT

CHOCOLATE, LITTLE CHOCOLATE, AND LYNN BAYOU WATERSHED

CALHOUN COUNTY, TEXAS

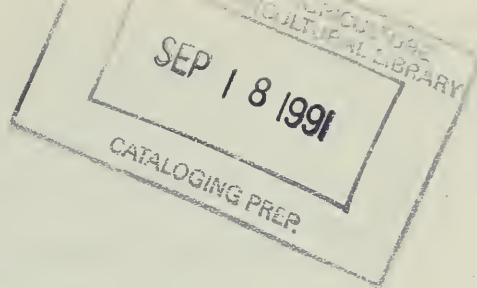


November 1964

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WORK PLAN
FOR
WATERSHED PROTECTION, FLOOD PREVENTION
AND AGRICULTURAL WATER MANAGEMENT

CHOCOLATE, LITTLE CHOCOLATE, AND LYNN BAYOU WATERSHED

Calhoun County, Texas

Prepared Under the Authority of the Watershed Protection and Flood Prevention Act, (Public Law 566, 83rd Congress; 68 Stat. 666), as amended.

Prepared By:

Calhoun-Victoria Soil Conservation District
(Sponsor)

Calhoun County Drainage District No. 11
(Sponsor)

Calhoun County Commissioners Court
(Sponsor)

With Assistance By:

U. S. Department of Agriculture
Soil Conservation Service
November 1964

WATERSHED WORK PLAN

CHOCOLATE, LITTLE CHOCOLATE, AND LYNN BAYOU WATERSHED
Calhoun County, Texas
November 1964

SUMMARY OF PLANGeneral Summary

The work plan for watershed protection, flood prevention, and agricultural water management for Chocolate, Little Chocolate, and Lynn Bayou watershed was prepared by the Calhoun-Victoria Soil Conservation District, Calhoun County Drainage District No. 11, and Calhoun County Commissioners Court as sponsoring local organizations. Technical assistance was provided by the Soil Conservation Service of the United States Department of Agriculture.

It is significant that the entire cost of developing this work plan was borne by the Calhoun County Drainage District No. 11.

The objectives of the project are to provide proper land use and treatment in the interest of soil and water conservation, drainage, and flood protection for the lands along Chocolate, Little Chocolate, and Lynn Bayou. The project, as formulated, meets these objectives.

The watersheds of Chocolate and Little Chocolate Bayous are located partially within Calhoun County and partially within Victoria County. The watershed of Lynn Bayou is located entirely within Calhoun County. The area involved in this project includes only that portion which lies within Calhoun County. This is a watershed area of 67.45 square miles or 43,168 acres. Approximately 47 percent of the project area is cropland, 14 percent is pasture, 31 percent is rangeland, and 8 percent is in miscellaneous uses such as urban areas, roads, railroad rights-of-way, farmsteads, and stream channels.

There are no Federal lands in the project area.

The principal problem is one of frequent and extensive flooding of inadequately drained agricultural land.

The work plan proposes installing in a 5-year period, a project for the protection and development of the project area at a total estimated installation cost of \$1,250,502. The share to be borne by Public Law 566 funds is \$457,181. The share to be borne by other than Public Law 566 funds is \$793,321. In addition, the local interests will bear the entire cost of operation and maintenance.

Land Treatment Measures

Landowners and operators will establish land treatment which will help accomplish the project objectives. Primarily, this treatment will consist

of measures, or combinations of measures, which contribute directly to watershed protection, flood prevention, and agricultural water management. Acres, by land use, to be treated during the 5-year installation period, are listed in table 1.

The cost for land treatment measures is estimated to be \$433,564, of which \$422,118 will be borne by other than Public Law 566 funds. This amount includes expected reimbursements from the Agricultural Conservation Program Service and \$9,992 to be spent by the Soil Conservation Service for technical assistance under its going program during the project installation period. The Public Law 566 share, consisting entirely of accelerated technical assistance, is \$11,446.

Structural Measures

Structural measures to be installed in a 2-year period are 69.7 miles of main and lateral ditches and 407 structures for water control. The total cost of structural measures is \$816,938 of which the Public Law 566 share is \$445,735. The local share is \$371,203, of which 89.5 percent is for land, easements, and rights-of-way; 10 percent for construction; and 0.5 percent for administering contracts.

Damages and Benefits

The reduction of flooding and the improvement of drainage outlets will directly benefit 83 owners and operators of 25,663 acres of agricultural land in addition to landowners along Lynn Bayou in Port Lavaca. The project will provide a 5-year level of protection to agricultural lands and a 100-year level of urban protection for Port Lavaca along Lynn Bayou. The average annual primary benefits expected to accrue to the structural measures are \$207,948 from reduction of floodwater damage and drainage of agricultural land. Net secondary benefits of \$32,871 will result from the project.

The ratio of the total annual project benefits (\$240,819) to the average annual cost of structural measures (\$50,640) is 4.8:1.

Provisions for Financing Local Share of Installation Cost

Calhoun County Drainage District No. 11 has authority for taxation and the right of eminent domain under applicable State laws. A bond issue has been approved to authorize the district to issue bonds in the amount of \$450,000 to finance the local share of the cost of structural measures. Calhoun County Drainage District No. 11 plans to use the loan provisions of the Watershed Protection and Flood Prevention Act.

Operation and Maintenance

Land treatment measures, including on-farm drainage systems, will be operated and maintained by landowners or operators of the farms on which the measures will be installed under agreement with the Calhoun-Victoria Soil Conservation District.

The Calhoun County Drainage District No. 11 will be responsible for the operation and maintenance of the improved channels, group mains, and laterals with appurtenances. Adequate revenue for this will be provided from a special district tax which has been voted for this purpose. The estimated average annual value of operation and maintenance of the channels and structures is \$14,580.

DESCRIPTION OF WATERSHED

Physical Data

Chocolate, Little Chocolate, and Lynn Bayou watershed is located in Calhoun and Victoria Counties in the Coast Prairie Land Resource Area of Texas. The area involved in this project includes only that area which lies within Calhoun County. This is a watershed area of 43,168 acres (67.45 square miles). The three streams are adjacent and are inter-related with respect to drainage and flood problems. The Calhoun County Drainage District No. 11 encompasses 32,500 acres, all of which are located in the watershed.

Chocolate Bayou heads near the community of Guadalupe in Victoria County and flows about 25 miles southeast, crossing Calhoun County Drainage District No. 11, to enter Chocolate Bay. Agua Dulce Creek is a major tributary joining Chocolate Bayou about four miles upstream from Chocolate Bay.

The Little Chocolate Bayou watershed lies almost entirely within the project area. The stream heads in Victoria County about 8 miles northwest of Port Lavaca and flows approximately 8 miles southeast, entering Chocolate Bay 2 miles southwest of Port Lavaca. There are no major tributaries.

The Lynn Bayou watershed lies entirely within the project area. The stream heads about three miles northwest of Port Lavaca, flows through the northern part of Port Lavaca, and enters Lavaca Bay.

The topography is a nearly level coastal plain with a gently rising slope from sea level at bay side to about 75 feet above mean sea level along the western watershed divide. The highest elevation within the project area is about 50 feet above mean sea level.

The watershed is underlain by the Beaumont formation of the Pleistocene system, which consists of highly plastic, poorly bedded clay interbedded with lentils of sand.

The soils are mostly dark clays with slow and very slow internal and surface drainage. The soils series are primarily Lake Charles and Beaumont with small isolated inclusions of Bernard and Edna.

The over-all land use in the watershed is:

| <u>Land Use</u> | <u>Acres</u> | <u>Percent</u> |
|------------------|---------------|----------------|
| Cropland | 20,260 | 46.9 |
| Pasture | 5,899 | 13.7 |
| Rangeland | 13,509 | 31.3 |
| Miscellaneous 1/ | 3,500 | 8.1 |
| Total | 43,168 | 100.0 |

1/ Includes roads, highway and railroad rights-of-way, towns, farmsteads, stream channels, etc.

The cropland is used primarily for row crops which produce little effective hydrologic cover. Pasture and rangeland have hydrologic cover conditions ranging from good to poor, with the majority classified as fair. Annual weeds and woody vegetation increase with overuse.

The climate is warm and sub-humid. Mean monthly temperatures range from 57 degrees Fahrenheit in January to 83 degrees in July. The normal growing season, extending from February 18 to December 10, is 295 days. The average annual rainfall is 37 inches. Monthly averages range from 1.15 inches in January to 4.90 inches in October. Hurricanes, which strike the area occasionally, are accompanied by heavy rainfall.

Water for livestock and domestic use is obtained primarily from shallow wells.

Economic Data

The economy of the project area is based on agriculture, manufacturing, construction, mineral extracting, marine production, and tourist trade. The agricultural economy is supported by the production of cotton, grain sorghum, forage crops, and beef cattle. Most of the economic activity not associated directly with agriculture is confined to Port Lavaca.

There are approximately 111 farms and ranches in the project area of which about 83 are located in the drainage district. The average size of the farms engaged in cash crop production is about 250 acres and represents an investment in land and improvements of about \$50,000 per farm. Several large ranches are located in the watershed.

Intensive farming is practiced on the farms. Approximately 83 percent of the farm acreage is used for crop production. Cotton is grown on 38 percent of the cropland area, 58 percent is used for grain sorghum, and 4 percent for forage crops.

The trend in the project area will be to convert some of the rangeland to improved pasture and increase the efficiency in production of beef cattle.

It is expected that the acreages devoted to cash crops will remain unchanged. The acreage now devoted to these crops is significant to the watershed economy and to producers who depend upon these crops for a major portion of the family income.

More than half of the farms are owner-operated, and there are no operating farm or ranch units in the watershed with total sales of less than \$2,500.

The value of cropland ranges from about \$200 to \$400 per acre and with flood protection and adequate drainage most of the cropland will be valued at the higher amount.

The economy of the area is expected to continue to expand, and the population is expected to increase fairly rapidly.

Port Lavaca, located in the project area, had a population of 8,864 in 1960 and an estimated population of 10,000 in 1962. According to the "Port Lavaca Plan" prepared for the City Planning Board, the population is expected to reach 32,500 by 1985.

The area is served by the Coastal Highway (State 35), U. S. Highway 87, and the Southern Pacific Railroad, as well as channels connecting to the new Matagorda ship channel and the Intercoastal Waterway. The 6 miles of county hard surface and about 21 miles of shell road in the drainage district provide excellent travel routes between farms and markets.

Land Treatment Data

The Soil Conservation Service work unit at Port Lavaca is assisting the Calhoun-Victoria Soil Conservation District. There are 111 operating units in the project area, of which 51 with a total of 27,286 acres, are under district agreement. The work unit has assisted Soil Conservation District cooperators in preparing 24 basic soil and water conservation plans covering 23,000 acres and has given technical assistance in establishing and maintaining planned measures. Current revision is needed on 12 conservation plans. Satisfactory soil surveys have been made on 13,200 acres, leaving 29,968 acres needing additional soil surveys.

Needed land treatment measures have been established on 8 percent of the cropland, 6 percent of the pastureland, and 20 percent of the rangeland (table 1A). The following tabulation shows, by land use, the present status of land treatment.

| <u>Land Use</u> | <u>Unit</u> | <u>Adequately Treated</u> |
|-----------------|-------------|---------------------------|
| Cropland | Acre | 1,560 |
| Pastureland | Acre | 350 |
| Rangeland | Acre | 2,730 |

Further land treatment cannot proceed until adequate drainage is obtained.

WATERSHED PROBLEMS

Floodwater Damage

Because of the flat topography of the watershed, most of the damages result from the accumulation of excess water from rainfall within the area.





Cultivated Crop Being Damaged From Flooding and Inadequate Drainage



Lack of Proper Outlets Causes Poor Drainage



Flooding and subsequent flood damage is the major problem on the agricultural land in the watershed. Flooding occurs most frequently during the time crops are on the land.

Under present conditions landowners are unable to plant about 2,500 acres each year because of the slow removal of excess surface runoff. Crops drown out each year on an additional 1,500 acres of the planted acreage. Average annual floodwater damage to crops and pasture is estimated to be \$106,050 (table 5).

Damages to roads and bridges and to other agricultural properties were found to be insignificant when considered on an average annual basis. Consequently, they were not included in monetary damage estimates.

Major urban damage in Port Lavaca is caused by floodwater of Lynn Bayou from a flood producing storm such as occurred in 1960. This storm, however, was greatly in excess of a 100-year frequency event and resulted from a tropical disturbance that produced rainfall of almost 30 inches in a 24 hour period. The urban damage from a 100-year frequency flood is estimated to be \$21,800. However, the average annual amount is small, totaling only about \$325.

Sediment and Erosion Damage

Erosion and sediment production rates are very low because of the nearly level topography. The estimated annual rate of sediment production is 0.2 acre-foot per square mile.

Problems Relating to Water Management

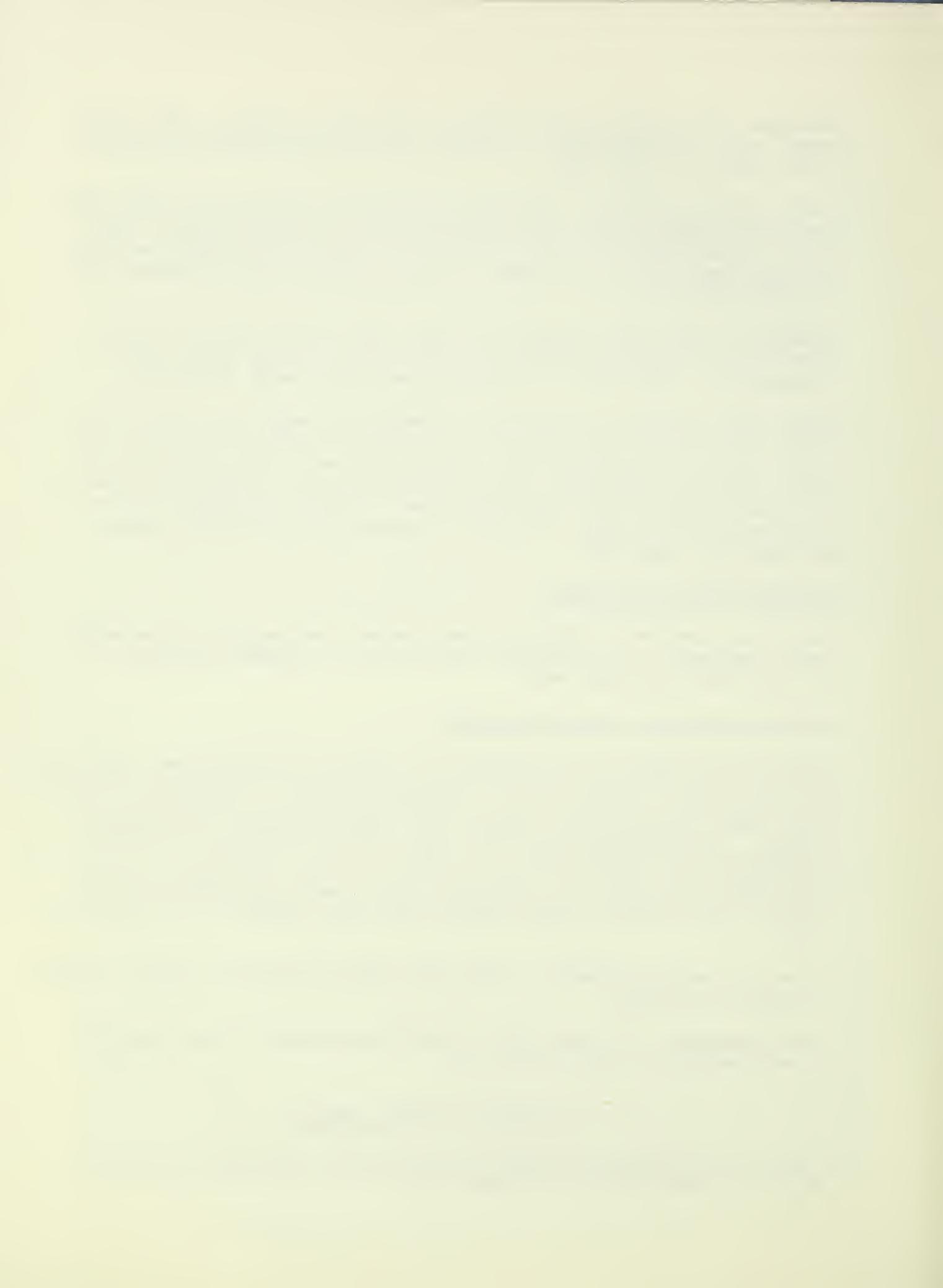
Agricultural damages from floodwater and inadequate drainage are inseparable. Surface drainage is required for the clay soils which are predominantly the Lake Charles and Beaumont series. Proper drainage on most of the agricultural land in the watershed has not been attained because of inadequate outlets. On the predominantly wet lands losses ranging up to 50 percent are sustained from reduced yields and quality of crops. Abnormally wet soil conditions also prevent the operation of farm machinery during critical periods from planting through harvest time which results in increased crop costs.

Proper use and improvement of range and pasture grasses are limited because of the poor drainage.

Water management for enhancement of fish and wildlife or for irrigation is not practiced in the project area.

PROJECTS OF OTHER AGENCIES

There are no existing or proposed water resource development projects of any other agency within the project area.



The works of improvement in this plan, when installed, will be beneficial to existing and proposed drainage facilities in Victoria County Drainage Districts Nos. 2 and 3 by providing outlets for excess water.

Measures included in this project will have no known detrimental effects on any existing or proposed downstream works of improvement.

BASIS FOR PROJECT FORMULATION

The local sponsors requested that a work plan be prepared for watershed protection, flood prevention, and agricultural water management. The continued high losses sustained by the agricultural community from flood-water and inadequate drainage have emphasized the need for development of a plan.

Topography of the land and physical characteristics of the watersheds prevent the use of floodwater retarding structures. Therefore, based on field investigations and surveys, it was determined that improved channels, group laterals, and appurtenances with on-farm drainage systems would provide the most effective and economical means for timely removal of excess water from the area.

The sponsors requested a 5-year level of flood protection on agricultural land, the removal of excess water within 2 days from cropland, and adequate outlets for drainage of range and pasture land. Consideration will be given to existing fish and wildlife resources in design of structural measures.

In addition, they requested channel improvement of Lynn Bayou to prevent any major floodwater damages to residences in Port Lavaca from overflows resulting from storms up to and including a 100-year frequency event.

The agricultural land in the watershed is very fertile and, when adequately drained and protected from flooding, is capable of producing high crop and pasture yields. The operators are progressive and use high level management practices to achieve efficient production. These factors influenced the sponsors to plan for a high level of protection.

It was agreed to include land treatment measures, necessary multiple-purpose channels, lateral ditches, and appurtenances which would meet these needs. The local sponsors have the financial ability and the determination to carry out the agreed upon objectives. These works of improvement will serve lands currently in agricultural production. They will include measures for protection and for efficient and sustained productive use within the capability of the soils, giving consideration to crops to be grown.

The land areas of the Victoria County Drainage Districts Nos. 2 and 3, lying above the project, and drainage from which enters this project area, is to be considered in design of planned structural works of improvement. Local sponsors understand that additional channel capacities must be provided to handle the waters from the upstream districts which have some

drainage measures installed. At present, waters removed by these measures are released into channels which enter this project area.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures

The Calhoun-Victoria Soil Conservation District is assisting farmers and ranchers in the planning and application of basic soil and water conservation plans on their land. The application of the planned practices, based on the use of each acre within its capabilities and treatment in accordance with its needs, is an essential part of a sound program for watershed protection, flood prevention, and agricultural water management.

The extent of needed land treatment measures which have been applied to date within the project area represents an estimated expenditure by land-owners and operators of \$54,372 including reimbursements from Agricultural Conservation Program Service (table 1A).

Table 1 includes estimates of the acreage in each major land use which will receive accelerated land treatment during the 5-year installation period. These measures will be established and maintained by the landowners and operators in cooperation with the local soil conservation district. In addition to the presently available technical assistance, \$10,178 will be made available from P. L. 566 funds to accelerate the establishment of needed practices and measures. An additional \$1,268 from P. L. 566 funds will be provided to complete the essential standard soil surveys at an early date.

During the installation period a combination of measures in keeping with a conservation cropping system will be initially applied on 14,647 acres of cultivated land for soil conditioning and protection from erosion. The conservation cropping system includes green manure and cover crops and crop residue use.

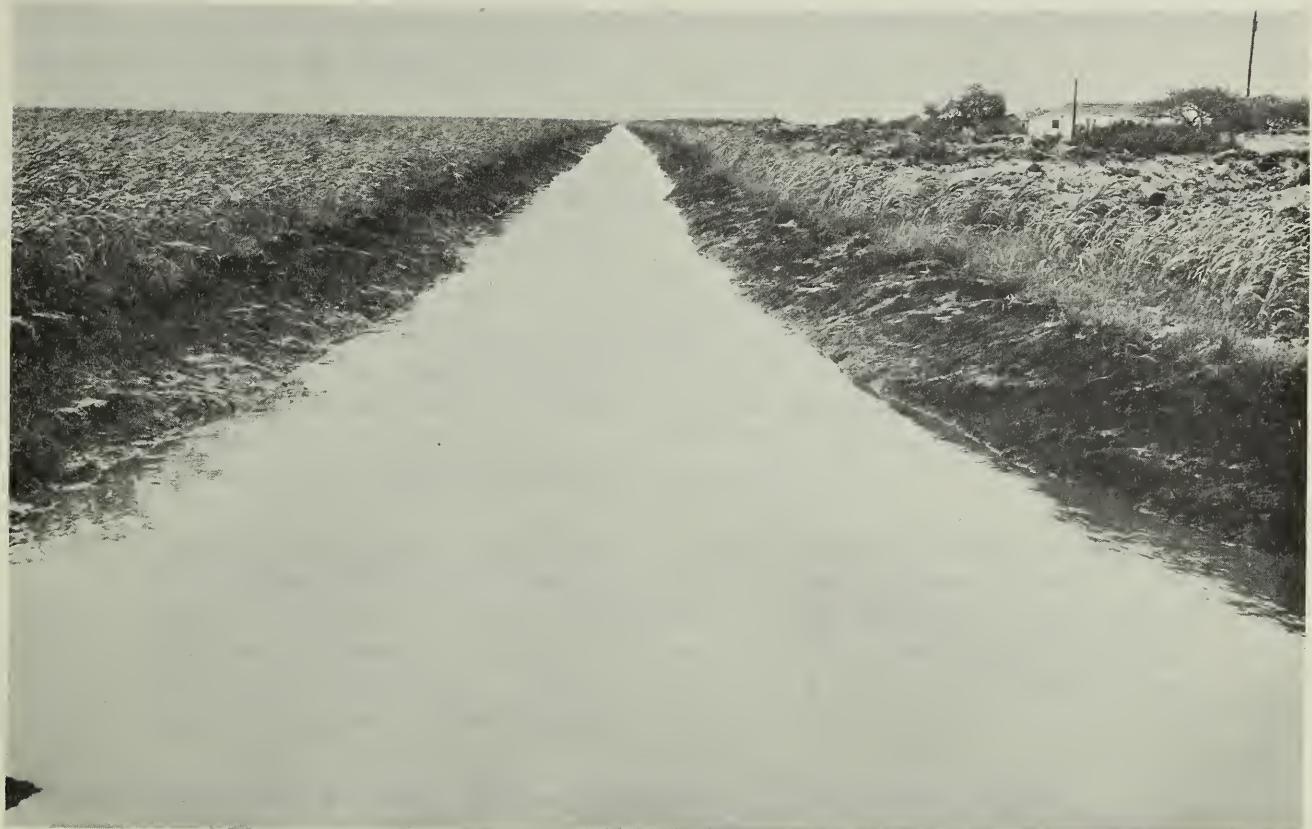
Proper use will be practiced on 4,369 acres of improved pasture. About 900 acres will be cleared of weeds and scattered brush and will be protected for use as pasture. About 600 acres of pasture and hayland will be renovated, and pasture and hayland planting will be applied on about 200 acres to attain a good base grass cover. The trend is toward conversion of brushy rangeland to hay or pasture use.

Preservation and improvement of vegetative cover on rangeland is also important to meet project objectives. Proper use will be practiced on 9,428 acres of rangeland.

Drainage mains or laterals, drainage field ditches, and structures for water control will be installed on farms and ranches to attain adequate drainage for maximum effectiveness of other land treatment practices.

Land treatment measures associated with the conservation, development, utilization, and disposal of water are especially important in this project.





Drainage Main Functioning Properly



Recently Constructed Drainage Main, Showing Low Water
Crossing With Trickle Tube Functioning and Water Gap Upstream



Benefits expected to accrue to the project are dependent on installation of adequate on-farm drainage systems.

Structural Measures

Planned structural measures to be installed are shown on the Project Map, figure 2, and include the following:

1. Chocolate Bayou (I) - Re-alignment, enlargement and clearing of 14.5 miles of Chocolate Bayou from approximately 10,000 feet below the southern boundary of the drainage district (sta. 237+00) to the northern boundary of the drainage district (Victoria-Calhoun County line - sta. 1,004+50). There will be 10.5 miles of lateral construction and enlargement.
2. Little Chocolate Bayou (II) - Enlargement and clearing of 9.5 miles of Little Chocolate Bayou from approximately 5,100 feet below the southern boundary of the district (sta. 67+00) to approximately 0.15 mile from the Victoria-Calhoun County line (sta. 568+50). There will be 8.8 miles of lateral construction and enlargement.
3. Agua Dulce Creek (III), tributary of Chocolate Bayou - Enlargement and clearing of 6.5 miles of Agua Dulce Creek from its confluence with Chocolate Bayou (sta. 0+00) to about 2.0 miles from the Victoria-Calhoun County line (sta. 352+25). There will be 12.3 miles of lateral construction and enlargement.
4. Lynn Bayou (IV) - Enlargement and clearing of 3.2 miles of Lynn Bayou from Lavaca Bay (sta. 0+00) to approximately 0.4 mile from the boundary between Calhoun County Drainage Districts Nos. 11 and 6. There will be 4.2 miles of lateral construction and enlargement.
5. Removal of undesirable woody vegetation from the channel sections of Chocolate and Little Chocolate Bayous from State Highway 35 to their outlets at Chocolate Bay. Removal of woody vegetation on Lynn Bayou from State Highway 35-A to its outlet at Lavaca Bay. This will be done by clearing or controlled use of herbicides in such a manner as to reduce the retardance factor while retaining the esthetic appearance and value of the area. This will have the added effect of reducing the mosquito population, which will be of considerable importance to Port Lavaca and the area.
6. Mains and laterals, 4 feet deep or greater, have been planned with 6 pipe drop structures per mile of channel with a total of 400 structures. These structures are to be located in the field as construction progresses and therefore are not shown on the Project Map. Also included in the project are seven lateral drop structures, shown on the Project Map, figure 2.



This cost is included in table 2.

Figure 1 shows a section of a typical pipe drop structure.

The multiple-purpose mains will provide adequate outlets for laterals and on-farm drainage systems and will have sufficient capacity to provide flood protection from the 5-year frequency storm.

The multiple-purpose laterals will provide adequate outlets for on-farm drainage systems. They will have sufficient capacities to provide flood protection from storms with a frequency of occurrence ranging from 2 to 5 years, depending on the use of the land to be protected.

The estimated total cost of installing these measures is \$816,938, of which \$354,309 is for mains and their appurtenances. The remaining \$462,629 is for laterals and their appurtenances.

Details on quantities, costs, and design features of structural measures are given in tables 1, 2, 3, and 3A.

No structural measures will be installed for the primary purpose of bringing new land into agricultural production.

EXPLANATION OF INSTALLATION COST

The estimated cost of planning and applying land treatment measures by local interests during the 5-year installation period will be \$422,118 based on current program criteria. This includes \$9,992 of Public Law 46 technical assistance funds furnished by the Soil Conservation Service in cooperation with the local soil conservation district and the cost sharing assistance provided by the Agricultural Conservation Program Service. Accelerated technical assistance will be provided to landowners and operators by the Soil Conservation Service at an estimated cost of \$11,446 from Public Law 566 funds. This amount includes \$1,268 for the completion of standard soil surveys. Costs are based on prices presently being paid by local farmers to establish these measures.

Cost allocation for multiple-purpose mains and laterals serving both flood prevention and agricultural water management was based on the procedure set forth in second alternative (Watershed Protection Handbook 1132.212). Under this procedure it was determined that 50.1 percent of installation cost should be allocated to flood prevention and the remaining 49.9 percent allocated to agricultural water management. Details for cost allocation and cost sharing are presented in Investigations and Analyses.

The engineers estimate of construction cost was based on unit cost of structural measures constructed in similar areas. Ten percent was added to the engineers estimate to provide for unpredictable construction costs. The share of construction cost to be borne by Public Law 566 funds is \$358,496 and that to be borne by other funds is \$37,118.



Installation services include engineering and administrative costs and were based on Service experience for similar works. The total cost for installation services, \$87,239, will be borne by Public Law 566 funds.

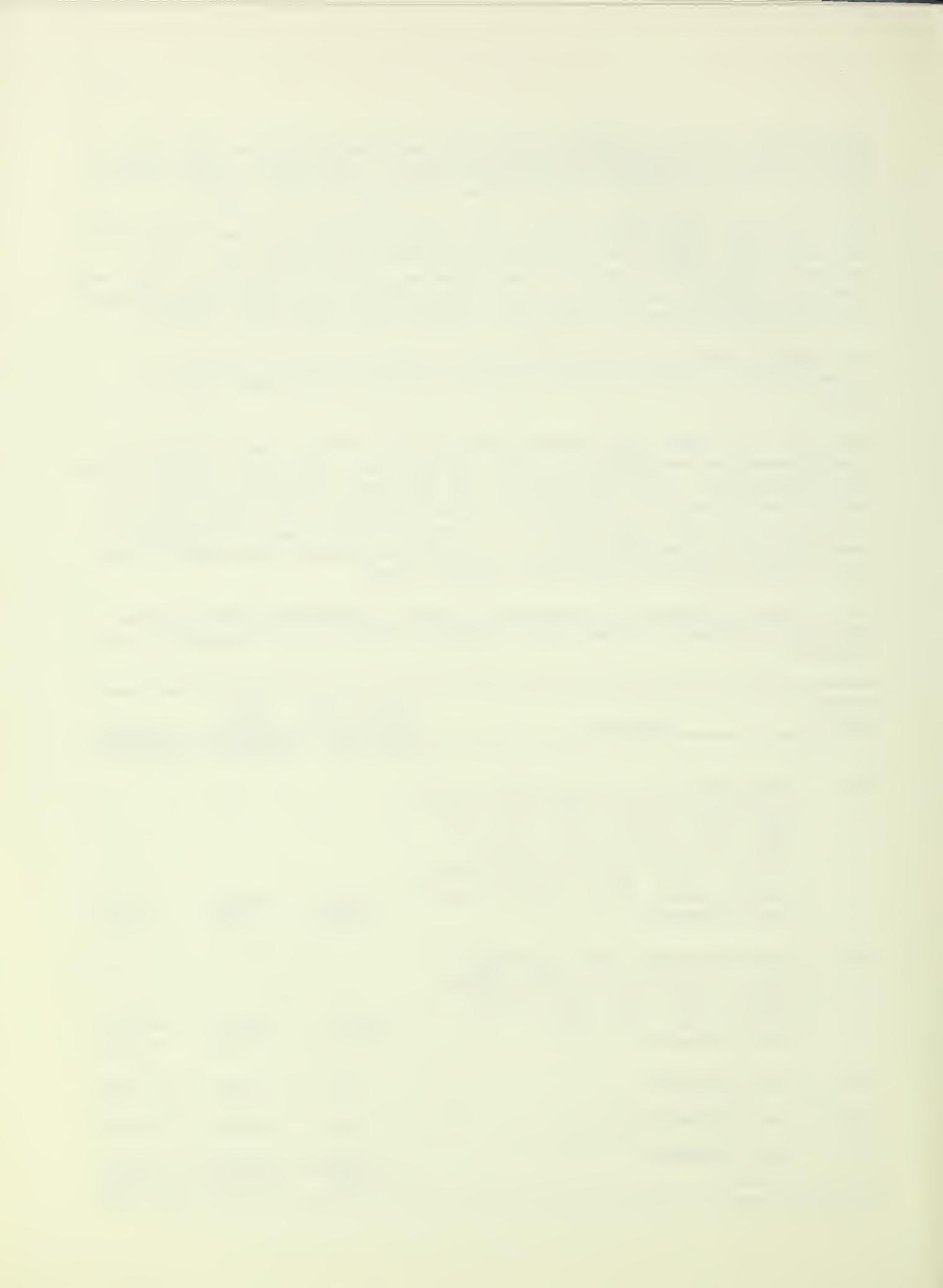
Land, easement, and rights-of-way costs will be borne by other than Public Law 566 funds. These are estimated at \$332,085 and consist of: land easements, \$115,800; changes in improvements, \$25,000; bridge additions and changes, culvert, and low water crossings, \$81,485; pipeline modifications, \$70,200; construction of water gaps, \$37,600; and legal fees, \$2,000.

The value of the cost of administration of construction contracts is estimated to be \$2,000 and will be borne by other than Public Law 566 funds.

Public Law 566 funds will bear \$241,909 of the \$409,286 cost allocated to flood prevention and \$203,826 of the \$407,652 cost allocated to agricultural water management. Other than Public Law 566 funds will bear \$167,377 of the cost allocated to flood prevention and \$203,826 of the cost allocated to agricultural water management. In summary, Public Law 566 funds will bear \$445,735 of the \$816,938 total project installation cost and \$371,203 will be borne by other than Public Law 566 funds.

The estimated schedule of obligations for the 5-year installation period covering installation of both land treatment and structural measures is as follows:

| Fiscal : | Measures | : Public Law: : 566 Funds | Other: : Funds | Total (dollars) |
|----------|---|------------------------------|-------------------|--------------------|
| 1st | Chocolate Bayou and Agua Dulce Mains; Laterals I-A, I-B, I-C, I-D, I-E, I-F, I-F1, I-F1a, I-F2, I-G, I-J, I-K, I-L, III-A, III-B, III-B1, III-B2, III-H, III-H1, III-H2, III-C, III-C1, III-D, III-E, III-F, III-G Land Treatment | 303,080 2,286 | 244,365 42,212 | 547,445 44,498 |
| 2nd | Little Chocolate and Lynn Bayou Mains; Laterals II-A, II-B, II-B1, II-B1a, II-C, II-D, II-E, IV-A, IV-A1, IV-A2, IV-B, IV-C Land Treatment | 142,655 2,036 | 126,838 84,424 | 269,493 86,460 |
| 3rd | Land Treatment | 3,053 | 126,635 | 129,688 |
| 4th | Land Treatment | 3,053 | 126,635 | 129,688 |
| 5th | Land Treatment | 1,018 | 42,212 | 43,230 |
| | Total | 457,181 | 793,321 | 1,250,502 |



This schedule may be adjusted from year to year on the basis of any significant changes in the plan found to be mutually desired and in the light of appropriations and actual accomplishments.

EFFECTS OF WORKS OF IMPROVEMENT

Installation of the structural measures will provide benefits to about 83 landowners and operators through flood protection and timely removal of excess water from 25,663 acres of agricultural land. No change in acreage is expected on any crops now under allotment or marketing quotas. Approximately 79 percent of the land is used for forage hay, pasture and range and no change in land use was indicated. Greater efficiency in farming operation can be realized by farmers.

Establishment of the land treatment program will reduce the cost of removing sediment from the drainage facilities and reduce other maintenance costs.

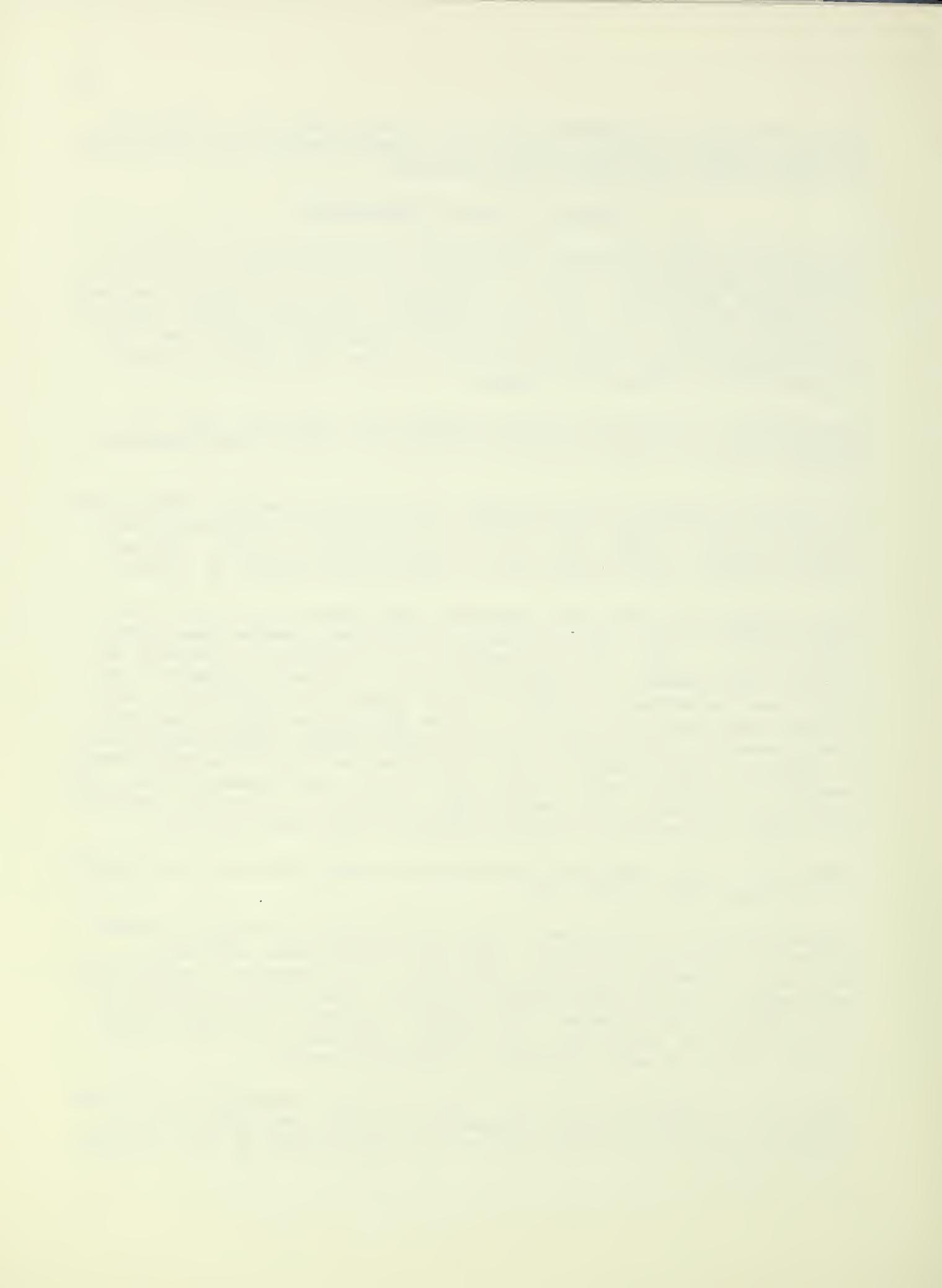
The combined program of land treatment and structural measures will prevent most agricultural damage from all flood producing storms up to a 5-year frequency event. Excess water will be removed within 2 days. Crop and pasture damages from flooding will be reduced approximately 89 percent.

Urban damages along Lynn Bayou resulting from floods up to the 100-year frequency flood event will be reduced to very minor damages when normal tides prevail. These remaining damages will be limited to backyards and backyard improvements. At the present time, a 100-year frequency flood would cause an estimated \$21,800 in urban damage along Lynn Bayou. When channel improvement is completed to allow for the increase in peak discharge caused by installation of the drainage project, these damages will be reduced to approximately \$1,800. Expressed in terms of average annual amounts, the damages without the project would be approximately \$325. With the project installed, the damages would be reduced to about \$25 annually. This degree of protection would not extend to hurricane situations.

There will be less delays and interruption of mail and school bus schedules and of other travel in the area.

Secondary benefits will accrue to trade area businesses through increased income from sales and services. The project will create additional employment opportunities by providing jobs for construction, operation and maintenance, and from the increase in volume of agricultural commodities to be marketed and processed. In addition, landowners will feel an increased sense of security in their farming operations and will be able to plan ahead with more confidence in future activities.

Some loss of wildlife habitat will result from the clearing along the main ditches, but the habitat of some species of birds, especially quail and doves, will improve with the application of the program of land treatment.



PROJECT BENEFITS

The total average annual benefits resulting from the installation of the project are estimated to be \$207,948. Of this total, \$104,124 will result from reduction of flood damage and \$103,824 will be in form of increased net income. The latter amount will result from reduced operating costs, improved crop quality and a more sustained level of production on the wetland area where adequate outlets are provided.

Secondary benefits, amounting to \$32,871 annually, will accrue to the local area through increased business activities resulting from the project.

Secondary benefits from a national viewpoint were not considered pertinent to the economic evaluations.

In addition to monetary benefits, there are other substantial benefits that will accrue to the project such as increased sense of security, better living conditions, and better health conditions.

Calhoun County has not been designated as an area eligible for assistance under the Redevelopment Act. Consequently, no redevelopment benefits were considered.

COMPARISON OF BENEFITS AND COSTS

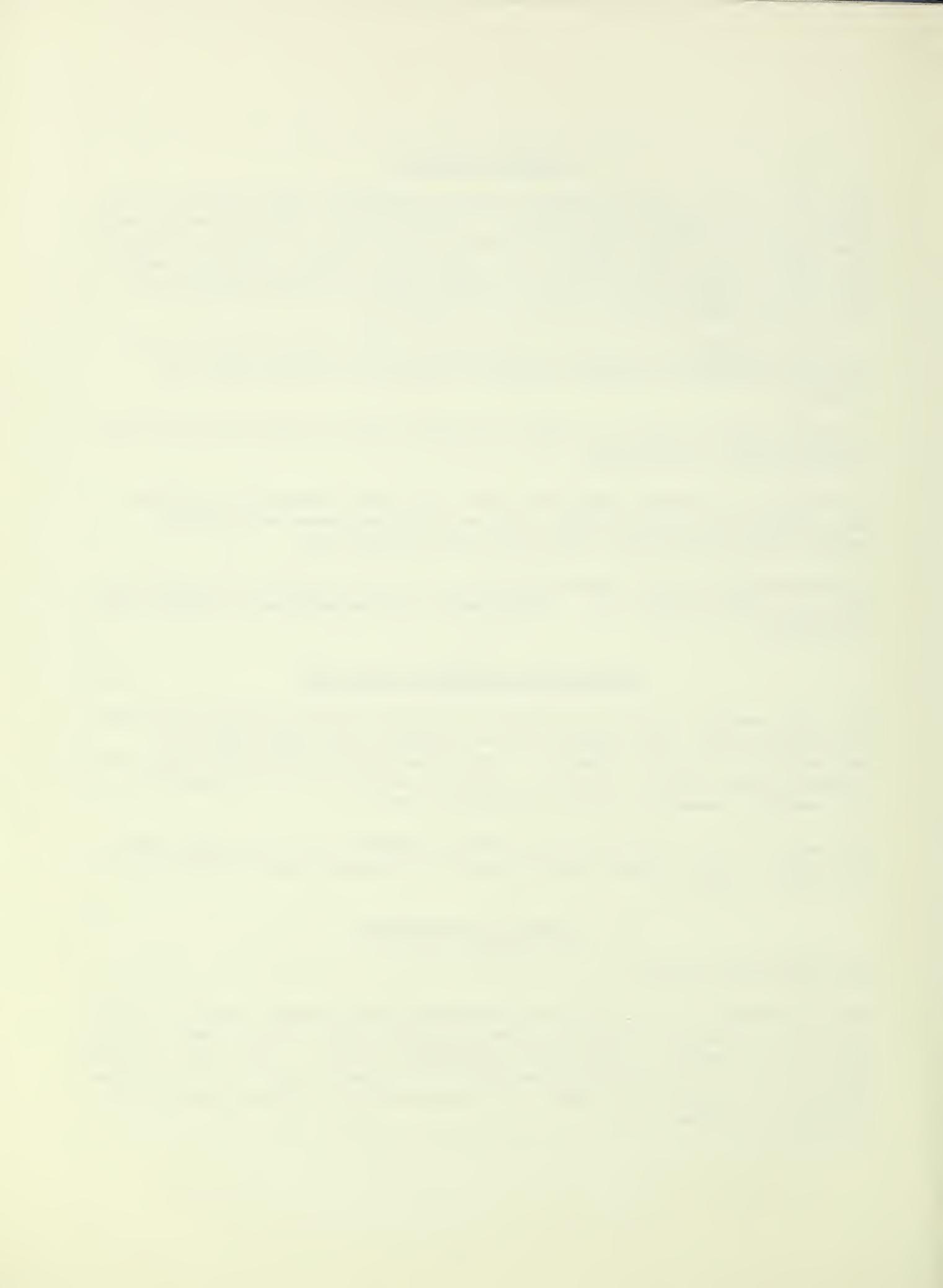
The total average annual cost of the structural measures (amortized total installation cost, plus annual cost of operation and maintenance) is estimated to be \$50,640 (table 4). These measures are expected to produce average annual primary benefits of \$207,948 or \$4.10 for each dollar of cost making a benefit to cost ratio of 4.1 to 1.

The ratio of total average annual project benefits, including secondary, (\$240,819) to the average annual costs of structural measures (\$50,640) is 4.8 to 1 (table 6).

PROJECT INSTALLATION

Land Treatment Measures

Land treatment will be established by farmers and ranchers during a 5-year period in cooperation with the Calhoun-Victoria Soil Conservation District. Acres to be treated, by land use, are shown in table 1. The land treatment goal is to treat adequately 80 percent of the land during the installation period. In reaching this goal, it is expected that accomplishments will progress as follows:



| Land Use | FISCAL YEAR | | | | | Total (acres) |
|-------------|----------------|----------------|----------------|----------------|----------------|------------------|
| | 1st (acres) | 2nd (acres) | 3rd (acres) | 4th (acres) | 5th (acres) | |
| Cropland | 1,465 | 2,929 | 4,394 | 4,394 | 1,465 | 14,647 |
| Pastureland | 436 | 874 | 1,311 | 1,311 | 437 | 4,369 |
| Rangeland | 943 | 1,886 | 2,828 | 2,828 | 943 | 9,428 |
| Total | 2,844 | 5,689 | 8,533 | 8,533 | 2,845 | 28,444 |

Technical assistance in the planning and application of land treatment is provided under the going program of the district. A standard soil survey is in progress and has been completed on 13,200 acres. There are 29,968 acres needing standard soil survey. The needed survey will be completed during the first year of installation.

The governing body of the Calhoun-Victoria Soil Conservation District will assume aggressive leadership in getting an accelerated land treatment program underway. The landowners and operators will be encouraged to apply and maintain soil and water conservation measures on their farms and ranches. District owned equipment will be made available to landowners in accordance with existing arrangements for equipment usage in the district.

Technical assistance will be accelerated with Public Law 566 funds to insure installation of the planned measures during the installation period. These funds will be used by the Soil Conservation Service to assign additional technicians to the local soil conservation district to accelerate the application of soil, plant, and water conservation measures.

The Extension Service will assist with the educational phase of the program by conducting local meetings, preparing radio and press releases, and by other methods of getting information to the local people. This activity will facilitate the establishment of land treatment measures for agricultural water management and flood prevention.

Structural Measures

The Calhoun County Drainage District No. 11 has been legally organized under applicable state laws and has the right of eminent domain. The district has the revenue available from the sale of bonds to fulfill its responsibilities.

The Calhoun County Drainage District No. 11 will do the following in connection with project installation:

1. Obtain the necessary land, easements, rights-of-way, and permits for the 69.7 miles of multiple-purpose mains and laterals and the 407 water control structures. All legal instruments will be dedicated to the drainage district.

2. Obtain necessary flowage easements along the channels of Chocolate, Little Chocolate, and Lynn Bayous from the point where channel improvement stops downstream to Chocolate and Lavaca Bays.
3. Provide for the necessary relocation or modification of improvements, including utility lines and systems, bridges, and privately owned improvements.
4. Determine the legal adequacy of the easements for construction of the project and be the contracting agency, and let and service contracts for the construction of the project.
5. Provide the necessary legal, administrative, and clerical personnel, facilities, supplies, and equipment to advertise, award, and administer contracts for the construction of the multiple-purpose mains and laterals and water control structures.

Technical assistance will be provided by the Soil Conservation Service in preparation of plans and specifications, supervision of construction, preparation of contract payment estimates, final inspections, execution of certificate of completion, and related tasks necessary to install the planned works of improvement.

The general sequence for installing the structural measures during the two year installation period will be Chocolate Bayou and Agua Dulce drainage mains, laterals, and appurtenances the first year and Little Chocolate and Lynns Bayou mains, laterals, and appurtenances the second year. Construction will begin at a point immediately upstream from the State Highway 35 crossing of Chocolate and Little Chocolate Bayous and the State Highway 35-A crossing of Lynn Bayou. Construction of the laterals and water flow control structures will be carried out as work progresses upstream on the main ditches. At the same time bridges and culverts will be replaced, low water crossings and water gaps installed, and improvements relocated.

The clearing of undesirable woody vegetation along the channel sections of Lynn Bayou downstream from State Highway 35-A and Chocolate and Little Chocolate Bayous downstream from State Highway 35 will be accomplished during the first year.

The same pattern of construction will continue the second year until the project is completed at the upstream limits of the main and lateral ditches.

FINANCING PROJECT INSTALLATION

Federal assistance for carrying out works of improvement described in this work plan will be provided under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress; 68 Stat. 666) as amended.

Funds for the local share of the cost of this project will be provided by the Calhoun County Drainage District No. 11.

The voters of Calhoun County Drainage District No. 11 have approved a bond issue which authorized the district to issue \$450,000 in bonds to finance the local share of the project installation cost of the planned mains and laterals.

The Commissioners of Drainage District No. 11 plan to obtain a loan through the Farmers Home Administration to finance their share of the cost of this project. Negotiations currently are underway with the State Director, Farmers Home Administration, with whom a letter of intent has been filed. An adequate tax will be levied for retirement of bonds used to secure the loan. A tax rate not to exceed \$0.50 for each \$100 evaluation currently is being levied for the operation and maintenance fund.

It is anticipated that approximately 75 percent of the easements for the mains and laterals will be donated. The out-of-pocket costs of easements which will not be donated, local share of construction, relocation of utilities, roads and improvements, legal services, and administration of contracts is estimated by the sponsors to be \$295,000.

Structural measures will be constructed during a 2-year installation period pursuant to the following conditions:

1. All land, easements, and rights-of-way have been obtained for all structural measures, or a written statement is furnished by the Calhoun County Drainage District No. 11 that its right of eminent domain will be used, if needed, to secure any remaining easements within the project installation period. Sufficient funds are available, if needed, to pay for the remaining easements, permits, and rights-of-way.
2. Funds are available and sufficient to pay for the local share of construction costs.
3. The contracting agency is prepared to discharge its responsibilities.
4. Project and operation and maintenance agreements have been executed.
5. Public Law 566 funds are available.

The various features of cooperation between the participating parties have been covered in appropriate memorandums of understanding and working agreements.

The soil and water conservation loan program sponsored by the Farmers Home Administration is available to eligible farmers and ranchers in the area. Educational meetings will be held in cooperation with other agencies to outline available services and eligibility requirements.



The County Agricultural Stabilization and Conservation committee will cooperate with the governing body of the soil conservation district in selecting and providing financial assistance for those Agricultural Conservation Program Service practices which will accomplish the conservation objectives in the most efficient manner.

PROVISIONS FOR OPERATION AND MAINTENANCE

Land Treatment Measures

Land treatment measures will be maintained and re-applied when needed by landowners and operators. Representatives of the soil conservation and drainage districts will make periodic inspections of the land treatment measures to determine maintenance needs and encourage landowners and operators to perform the needed maintenance. District-owned equipment will be available in accordance with existing working arrangements.

Structural Measures

The estimated annual operation and maintenance cost of the improved channels, lateral ditches, and their appurtenant structures is \$14,500 based on long-term price levels. The Calhoun County Drainage District No. 11 will be responsible for the operation and maintenance of these structural measures and will accomplish the work through the use of contributed labor and equipment, by contract, by force account, or by a combination of these methods.

Calhoun County Drainage District No. 11 will establish a permanent reserve fund from tax revenue to be used for operation and maintenance of the structural measures. This tax, not to exceed \$0.50 per 100 dollars valuation, is providing \$10,000 to \$12,000 annual revenue at the present time under current valuations.

All structural measures will be inspected by representatives of the Calhoun County Drainage District No. 11 and Calhoun-Victoria Soil Conservation District after each heavy flow and at least annually. A Soil Conservation Service representative will participate in inspections at least annually.

For the improved channels and lateral ditches, items of inspection will include, but will not be limited to, the need for removal or control of woody vegetation, removal of sediment, corrective measures for sediment sources from side drains or spoil banks, and for prevention of gully erosion and head cutting. Waterflow control structures will be checked for condition of structural materials and for proper functioning.

The Soil Conservation Service in cooperation with the Calhoun-Victoria Soil Conservation District and the Calhoun County Drainage District No. 11 will participate to the extent of furnishing technical assistance to aid in inspection and to give technical guidance in performance of maintenance.

Provisions will be made for free access of representatives of the local sponsoring organizations and the Soil Conservation Service to inspect and provide needed maintenance for all structural measures at any time.

The Calhoun County Drainage District No. 11 will execute a specific operation and maintenance agreement prior to the issuance of invitation to bid on construction of the structural measures.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST

Chocolate, Little Chocolate, and Lynn Bayou Watershed, Texas

| | | | | Estimated Cost (Dollars) | <u>1/</u> |
|--------------|------------|---------|-----------|--------------------------|-------------|
| | | Number | | | |
| | | to be | Public | | : |
| | | Applied | Law | Other | : |
| Installation | Cost Items | Unit | <u>2/</u> | 566 Funds | Funds Total |

Land Treatment

Soil Conservation Service

| | | | | | |
|----------------------|------|--------|--------|---------|---------|
| Cropland | Acre | 16,207 | - | 366,918 | 366,918 |
| Pastureland | Acre | 4,719 | - | 40,038 | 40,038 |
| Rangeland | Acre | 12,158 | - | 5,170 | 5,170 |
| Technical Assistance | | | 11,446 | 9,992 | 21,438 |
| SCS Subtotal | | | 11,446 | 422,118 | 433,564 |
| TOTAL LAND TREATMENT | | | 11,446 | 422,118 | 433,564 |

STRUCTURAL MEASURES

Soil Conservation Service

| | | | | | | |
|-------------------------|-----------|------|---------|---------|--------|---------|
| Mains and Laterals | <u>3/</u> | Foot | 368,016 | 358,496 | 37,118 | 395,614 |
| Subtotal - Construction | | | | 358,496 | 37,118 | 395,614 |

Installation Services

Soil Conservation Service

| | | | |
|---|---------------|----------|---------------|
| Engineering Services | 53,051 | - | 53,051 |
| Other | 34,188 | - | 34,188 |
| Subtotal - Installation Services | 87,239 | - | 87,239 |

Other Costs

| | | | |
|------------------------------------|---|---------|---------|
| Land, Easements, and Rights-of-Way | - | 332,085 | 332,085 |
| Administration of Contracts | - | 2,000 | 2,000 |

Subtotal - Other - 334,085 334,085

TOTAL STRUCTURAL MEASURES 445.735 371.203 816.938

TOTAL PROJECT 457,181 793,321 1,250,502

SUMMARY

Subtotal SCS 457,181 793,321 1,250,502

TOTAL PROJECT 457 181 793 321 1 250 502

1/ Price Base: 1964

2/ For Land Treatment: Acres to be treated during project installation period.

3/ Includes 407 appurtenant water control structures.



TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT
 (at time of work plan preparation)

Chocolate, Little Chocolate, and Lynn Bayou Watershed, Texas

| Measures | | : Number | : Total Cost |
|--------------------------------|-----------|-------------|---------------|
| | : Applied | : (Dollars) | |
| | : Unit | : To Date | 1/ |
| LAND TREATMENT | | | |
| Conservation Cropping System | Acre | 1,560 | 47,190 |
| Crop Residue Use | Acre | 2,460 | 0 |
| Pasture Proper Use | Acre | 350 | 0 |
| Pasture and Hayland Renovation | Acre | 90 | 1,620 |
| Pasture and Hayland Planting | Acre | 134 | 2,412 |
| Range Proper Use | Acre | 2,730 | 0 |
| Structures for Water Control | No. | 9 | 3,150 |
| TOTAL | | | 54,372 |

1/ Price Base: 1964

November 1964



TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Chocolate, Little Chocolate, and Lynn Bayou Watershed, Texas

(Dollars) 1/

| Structure Number | Installation Cost-Public Law 566 Funds | | | Installation Cost - Other Funds | | | Total Construction & R/W Cost | | |
|---|--|-------------|--------|---------------------------------|----------|-----------|-------------------------------------|---------|---------|
| | Installation | Total | Other | Adm. ef. | Ease- | Installa- | | | |
| | Services | Public | | | | | | | |
| | Construction | Engineering | Law | Construction | Comments | Total | | | |
| Chocolate Bayou Main and Lateral | | | | 566 | | | | | |
| Drainage Main and Laterals | | | | | | | | | |
| I-A, I-B, I-C, I-D, I-E, I-F, I-F1, I-F1A, I-G, I-J, I-K, I-L | 112,725 | 13,683 | 10,521 | 136,929 | 11,669 | 500 | 114,000 | 126,169 | 263,098 |
| Water Control Structures <u>2/</u> | | | | | | | | | |
| Number 1 | 358 | 44 | 34 | 436 | 38 | - | - | 38 | 474 |
| Number 2 | 358 | 44 | 34 | 436 | 38 | - | - | 38 | 474 |
| Number 3 | 399 | 48 | 37 | 484 | 41 | - | - | 41 | 525 |
| Number 4 | 548 | 67 | 51 | 666 | 57 | - | - | 57 | 723 |
| Number 5 | 399 | 48 | 37 | 484 | 41 | - | - | 41 | 525 |
| 151 Pipe Drops | 35,371 | 4,294 | 3,302 | 42,967 | 3,663 | - | - | 3,663 | 46,630 |
| Subtotal | 150,158 | 18,228 | 14,016 | 182,402 | 15,547 | 500 | 114,000 | 130,047 | 312,449 |
| Little Chocolate Bayou Main and Lateral | | | | | | | | | |
| Drainage Main and Laterals | | | | | | | | | |
| II-A, II-B, II-B1, II-B1A, II-C, II-D, II-E | 65,641 | 10,866 | 6,348 | 82,855 | 6,797 | 500 | 90,076 | 97,373 | 180,228 |
| Water Control Structures <u>2/</u> | | | | | | | | | |
| 97 Pipe Drops | 22,723 | 3,761 | 2,197 | 28,681 | 2,352 | - | - | 2,352 | 31,033 |
| Subtotal | 88,364 | 14,627 | 8,545 | 111,536 | 9,149 | 500 | 90,076 | 99,725 | 211,261 |
| Agua Dulce Creek Main and Lateral | | | | | | | | | |
| Drainage Main and Laterals | | | | | | | | | |
| III-A, III-B, III-B1, III-B2, III-C, III-D, III-E, III-F, III-G, III-H, III-H1, III-H2 | 70,273 | 10,082 | 6,677 | 87,032 | 7,277 | 500 | 103,729 | 111,506 | 198,538 |
| Water Control Structures <u>2/</u> | | | | | | | | | |
| Number 6 | 398 | 57 | 38 | 493 | 42 | - | - | 42 | 535 |
| Number 7 | 769 | 110 | 73 | 952 | 78 | - | - | 78 | 1,030 |
| 111 Pipe Drops | 26,000 | 3,730 | 2,471 | 32,201 | 2,692 | - | - | 2,692 | 34,893 |
| Subtotal | 97,440 | 13,979 | 9,259 | 120,678 | 10,089 | 500 | 103,729 | 114,318 | 234,996 |
| Lynn Bayou Main and Lateral | | | | | | | | | |
| Drainage Main and Laterals | | | | | | | | | |
| IV-A, IV-A1, IV-A2, IV-B, IV-C | 12,929 | 3,567 | 1,359 | 17,855 | 1,339 | 500 | 24,280 | 26,119 | 43,974 |
| Water Control Structures <u>2/</u> | | | | | | | | | |
| 41 Pipe Drops | 9,605 | 2,650 | 1,009 | 13,264 | 994 | - | - | 994 | 14,258 |
| Subtotal | 22,534 | 6,217 | 2,368 | 31,119 | 2,333 | 500 | 24,280 | 27,113 | 58,232 |
| GRAND TOTAL | 358,496 | 53,051 | 34,188 | 445,735 | 37,118 | 2,000 | 332,085 | 371,203 | 816,938 |

1/ Price Base: 19642/ Appurtenant structures to Mains and Laterals.

November 1964



TABLE 2A - COST ALLOCATION AND COST SHARING SUMMARY

Chocolate, Little Chocolate, and Lynn Bayou Watershed, Texas

(Dollars) 1/

| Item | Purpose | | Total | |
|------------------------------------|----------------|--|----------------|--|
| | Flood | Agricultural Prevention:Water Management: | | |
| <u>COST ALLOCATION</u> | | | | |
| Multiple-Purpose | | | | |
| Mains, Laterals, and Appurtenances | 409,286 | 407,652 | 816,938 | |
| Total | 409,286 | 407,652 | 816,938 | |
| <u>COST SHARING</u> | | | | |
| Public Law 566 | 241,909 | 203,826 | 445,735 | |
| Other | 167,377 | 203,826 | 371,203 | |
| Total | 409,286 | 407,652 | 816,938 | |

1/ Price Base: 1964



TABLE 3 - STRUCTURE DATA

CHANNELS (Mains and Laterals)

Chocolate, Little Chocolate, and Lynn Bayou Watershed, Texas

| Channel Designation | Station Numbering for Reach | Watershed Area | Required Drainage | Required Drainage Curve | Planned Channel Capacity | Average Bottom Width | Average Side Slope | Average Depth | Average Grade | Average Velocity in ft./sec. | Volume of Excavation | | | | | | | | | |
|---------------------------------------|-----------------------------|----------------|--|-------------------------|--------------------------|-------------------------|--------------------|---------------|---------------|------------------------------|----------------------|--|--|--|--|--|--|--|--|--|
| | (100 ft.) | (100 ft.) | (acres) | (c.f.s.) | (c.f.s.) | (ft.) | (ft.) | (ft./ft.) | (ft./sec.) | (100 cu.yds.) | | | | | | | | | | |
| Chocolate Bayou | | | | | | | | | | | | | | | | | | | | |
| Main I | 1,004 | 878 | 20,495 | 50M 5/6 | 900 | 900 | 35 | 2:1 | 6.4 | 0.00060 | 3.0 | | | | | | | | | |
| | 878 | 719 | 24,501 | 50M 5/6 | 1,060 | 1,068 | 35 | 2:1 | 7.0 | 0.00060 | 3.1 | | | | | | | | | |
| | 719 | 590 | 28,685 | 50M 5/6 | 1,200 | 1,223 | 26 | 2:1 | 8.5 | 0.00045 | 3.4 | | | | | | | | | |
| | 590 | 485 | 30,968 | 50M 5/6 | 1,280 | 1,300 | 22 | 2:1 | 9.3 | 0.00045 | 3.5 | | | | | | | | | |
| | 485 | 360 | 31,570 | 50M 5/6 | 1,300 | 1,317 | 16 | 2:1 | 10.6 | 0.00040 | 3.3 | | | | | | | | | |
| | 360 | 280 | Removal of undesirable woody vegetation from channel by clearing or by controlled use of herbicides. | | | | | | | | | | | | | | | | | |
| Laterals | | | | | | | | | | | | | | | | | | | | |
| I-L | 18 | 0 | 2,281 | 30M 5/6 | 87 | 89 | 4 | 2:1 | 4.1 | 0.00100 | 1.8 | | | | | | | | | |
| I-K | 35 | 0 | 373 | 30M 5/6 | 20 | 21 | 4 | 2:1 | 2.1 | 0.00100 | 1.2 | | | | | | | | | |
| I-J | 37 | 0 | 2,214 | 45M 5/6 | 127 | 130 | 4 | 2:1 | 5.6 | 0.00040 | 1.5 | | | | | | | | | |
| I-G | 39 | 0 | 197 | 45M 5/6 | 17 | 18 | 4 | 2:1 | 2.0 | 0.00080 | 1.1 | | | | | | | | | |
| I-F | 184 | 97 | 1,740 | 45M 5/6 | 103 | 131 | 6 | 2:1 | 4.6 | 0.00070 | 1.9 | | | | | | | | | |
| | 97 | 0 | 3,167 | 45M 5/6 | 170 | 171 | 6 | 2:1 | 5.2 | 0.00070 | 2.0 | | | | | | | | | |
| I-F1 | 66 | 0 | 900 | 30M 5/6 | 41 | 42 | 4 | 2:1 | 3.4 | 0.00050 | 1.1 | | | | | | | | | |
| I-F1A | 44 | 0 | 517 | 30M 5/6 | 28 | 30 | 4 | 2:1 | 2.9 | 0.00050 | 1.0 | | | | | | | | | |
| I-E | 13 | 0 | 728 | 30M 5/6 | 38 | Existing Ditch Adequate | | | | | | | | | | | | | | |
| I-D | 21 | 0 | 184 | 45M 5/6 | 16 | Existing Ditch Adequate | | | | | | | | | | | | | | |
| I-C | 44 | 0 | 221 | 45M 5/6 | 18 | 19 | 4 | 2:1 | 2.6 | 0.00045 | 0.8 | | | | | | | | | |
| I-B | 3 | 0 | 133 | 45M 5/6 | 12 | 14 | 4 | 2:1 | 1.4 | 0.00250 | 1.5 | | | | | | | | | |
| I-A | 57 | 43 | 248 | 45M 5/6 | 21 | 21 | 10 | 2:1 | 1.6 | 0.00070 | 1.0 | | | | | | | | | |
| | 43 | 0 | 458 | 45M 5/6 | 39 | 40 | 4 | 2:1 | 2.8 | 0.00100 | 1.5 | | | | | | | | | |
| Little Chocolate Bayou Main II | | | | | | | | | | | | | | | | | | | | |
| | 569 | 354 | 2,812 | 50M 5/6 | 172 | 177 | 12 | 2:1 | 5.0 | 0.00040 | 1.6 | | | | | | | | | |
| | 354 | 217 | 4,943 | 50M 5/6 | 275 | 280 | 18 | 2:1 | 5.0 | 0.00055 | 2.0 | | | | | | | | | |
| | 217 | 118 | 8,203 | 50M 5/6 | 420 | 420 | 9 | 2:1 | 5.6 | 0.00200 | 3.7 | | | | | | | | | |
| | 118 | 67 | Removal of undesirable woody vegetation from channel by clearing or by controlled use of herbicides. | | | | | | | | | | | | | | | | | |
| Little Chocolate Bayou | | | | | | | | | | | | | | | | | | | | |
| Laterals | | | | | | | | | | | | | | | | | | | | |
| II-E | 21 | 0 | 498 | 45M 5/6 | 34 | 35 | 4 | 2:1 | 3.0 | 0.00060 | 1.2 | | | | | | | | | |
| II-D | 17 | 0 | 553 | 45M 5/6 | 41 | 45 | 4 | 2:1 | 3.0 | 0.00100 | 1.5 | | | | | | | | | |
| II-C | 71 | 0 | 369 | 45M 5/6 | 31 | 34 | 10 | 2:1 | 2.6 | 0.00030 | 0.9 | | | | | | | | | |
| II-B | 145 | 59 | 1,153 | 45M 5/6 | 74 | 76 | 8 | 2:1 | 3.4 | 0.00075 | 1.5 | | | | | | | | | |
| | 59 | 0 | 1,967 | 45M 5/6 | 125 | 125 | 8 | 2:1 | 4.0 | 0.00100 | 1.9 | | | | | | | | | |
| II-B1 | 104 | 73 | 393 | 45M 5/6 | 32 | 32 | 4 | 2:1 | 2.7 | 0.00080 | 1.3 | | | | | | | | | |
| | 73 | 0 | 706 | 45M 5/6 | 58 | 59 | 5 | 2:1 | 3.4 | 0.00080 | 1.5 | | | | | | | | | |
| II-B1A | 15 | 0 | 118 | 45M 5/6 | 11 | 18 | 4 | 2:1 | 2.0 | 0.00090 | 1.1 | | | | | | | | | |
| II-A | 91 | 5 | 517 | 45M 5/6 | 38 | 43 | 4 | 2:1 | 3.0 | 0.00090 | 1.4 | | | | | | | | | |
| | 5 | 0 | 517 | 45M 5/6 | 38 | 90 | 4 | 2:1 | 3.0 | 0.00400 | 3.0 | | | | | | | | | |
| Agua Dulce | | | | | | | | | | | | | | | | | | | | |
| Main III | 352 | 218 | 7,973 | 50M 5/6 | 408 | 414 | 14 | 2:1 | 6.0 | 0.00085 | 2.0 | | | | | | | | | |
| | 218 | 100 | 10,750 | 50M 5/6 | 528 | 536 | 14 | 2:1 | 6.4 | 0.00085 | 3.1 | | | | | | | | | |
| | 100 | 0 | 12,907 | 50M 5/6 | 620 | 620 | 16 | 2:1 | 7.5 | 0.00050 | 2.7 | | | | | | | | | |
| Laterals | | | | | | | | | | | | | | | | | | | | |
| III-G | 35 | 0 | 609 | 30M 5/6 | 29 | 29 | 4 | 2:1 | 2.7 | 0.00065 | 1.2 | | | | | | | | | |
| III-F | 131 | 69 | 2,376 | 30M 5/6 | 96 | 101 | 4 | 2:1 | 4.8 | 0.00050 | 1.6 | | | | | | | | | |
| | 69 | 0 | 3,000 | 30M 5/6 | 110 | 111 | 4 | 2:1 | 5.0 | 0.00050 | 1.6 | | | | | | | | | |
| III-E | 58 | 0 | 1,189 | 30M 5/6 | 55 | 59 | 4 | 2:1 | 3.4 | 0.00100 | 1.6 | | | | | | | | | |
| III-D | 42 | 0 | 500 | 30M 5/6 | 30 | 31 | 4 | 2:1 | 2.5 | 0.00100 | 1.4 | | | | | | | | | |
| III-C | 36 | 0 | 606 | 45M 5/6 | 49 | 52 | 4 | 2:1 | 3.2 | 0.00100 | 1.6 | | | | | | | | | |
| III-C1 | 24 | 0 | 230 | 45M 5/6 | 19 | 22 | 4 | 2:1 | 1.8 | 0.00200 | 1.6 | | | | | | | | | |
| III-H | 73 | 34 | 472 | 45M 5/6 | 37 | 39 | 6 | 2:1 | 2.8 | 0.00064 | 1.2 | | | | | | | | | |
| | 34 | 0 | 624 | 45M 5/6 | 44 | 53 | 4 | 2:1 | 3.0 | 0.00140 | 1.8 | | | | | | | | | |
| III-H1 | 21 | 0 | 119 | 45M 5/6 | 13 | Existing Ditch Adequate | | | | | | | | | | | | | | |
| III-H2 | 4 | 0 | 52 | 45M 5/6 | 6 | 15 | 4 | 2:1 | 2.0 | 0.00050 | 0.9 | | | | | | | | | |
| III-B | 123 | 69 | 724 | 45M 5/6 | 54 | 58 | 4 | 2:1 | 3.8 | 0.00060 | 1.3 | | | | | | | | | |
| | 69 | 0 | 1,048 | 45M 5/6 | 74 | 75 | 4 | 2:1 | 3.8 | 0.00100 | 1.7 | | | | | | | | | |
| III-B1 | 9 | 0 | 61 | 45M 5/6 | 7 | 19 | 4 | 2:1 | 2.0 | 0.00100 | 1.2 | | | | | | | | | |
| III-B2 | 4 | 0 | 81 | 45M 5/6 | 7 | 19 | 4 | 2:1 | 2.0 | 0.00100 | 1.2 | | | | | | | | | |
| III-A | 90 | 0 | 558 | 45M 5/6 | 41 | 41 | 4 | 2:1 | 2.6 | 0.00150 | 1.7 | | | | | | | | | |
| Lynn Bayou | | | | | | | | | | | | | | | | | | | | |
| Main IV | 169 | 56 | 3,519 | 50M 5/6 | 249 | 249 | 7 | 2:1 | 5.0 | 0.00150 | 2.9 | | | | | | | | | |
| | 56 | 0 | Removal of undesirable woody vegetation from channel by clearing or by controlled use of herbicides. | | | | | | | | | | | | | | | | | |
| Laterals | | | | | | | | | | | | | | | | | | | | |
| IV-C | 42 | 0 | 413 | 45M 5/6 | 32 | 33 | 4 | 2:1 | 3.2 | 0.00040 | 1.0 | | | | | | | | | |
| IV-B | 15 | 0 | 284 | 45M 5/6 | 25 | 26 | 4 | 2:1 | 2.1 | 0.00150 | 1.5 | | | | | | | | | |
| IV-A | 133 | 81 | 902 | 45M 5/6 | 74 | 77 | 6 | 2:1 | 4.0 | 0.00055 | 1.4 | | | | | | | | | |
| | 81 | 0 | 1,298 | 45M 5/6 | 90 | 90 | 4 | 2:1 | 3.2 | 0.00030 | 2.7 | | | | | | | | | |
| IV-A1 | 18 | 0 | 130 | 45M 5/6 | 12 | 24 | 4 | 2:1 | 2.0 | 0.00150 | 1.5 | | | | | | | | | |
| IV-A2 | 14 | 0 | 167 | 45M 5/6 | 15 | 18 | 4 | 2:1 | 2.0 | 0.00085 | 1.1 | | | | | | | | | |
| IV-A3 | 3 | 0 | 127 | 45M 5/6 | 12 | 18 | 4 | 2:1 | 2.0 | 0.00085 | 3.0 | | | | | | | | | |

1/ The planned channel capacity and average depth are for water surfaces at approximately one foot below natural ground.

2/ The values given in these columns are at the lower end of each reach.



TABLE 3A - STRUCTURE DATAWATER CONTROL STRUCTURES

Chocolate, Little Chocolate, and Lynn Bayou Watershed, Texas

| Structure Number | :Required :Designed :Size of : | | | | Type of Structure |
|---------------------------------------|--------------------------------|-------|--------|-----------------------|-------------------|
| | :Capacity :Capacity :Opening : | | | Material | |
| | (cfs) | (cfs) | (inch) | | |
| Chocolate Bayou | | | | | |
| 1 | 23 | 25 | 24 | C.M.P. Asphalt Coated | Lateral Drop |
| 2 | 20 | 25 | 24 | C.M.P. Asphalt Coated | Lateral Drop |
| 3 | 48 | 67 | 30 | C.M.P. Asphalt Coated | Lateral Drop |
| 4 | 51 | 63 | 36 | C.M.P. Asphalt Coated | Lateral Drop |
| 5 | 21 | 31 | 30 | C.M.P. Asphalt Coated | Lateral Drop |
| Pipe Drops (151 Structures) <u>1/</u> | | | | | |
| Little Chocolate Bayou | | | | | |
| Pipe Drops (97 Structures) <u>1/</u> | | | | | |
| Agua Dulce Creek | | | | | |
| 6 | 51 | 86 | 30 | C.M.P. Asphalt Coated | Lateral Drop |
| 7 | 92 | 108 | 42 | C.M.P. Asphalt Coated | Lateral Drop |
| Pipe Drops (111 Structures) <u>1/</u> | | | | | |
| Lynn Bayou | | | | | |
| Pipe Drops (41 Structures) <u>1/</u> | | | | | |

1/ To be designed at time of detail for construction and will be 18 to 24 inch diameter c.m.p. asphalt coated with an operating head of 0.5 to 15.0 foot.

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TABLE 4 - ANNUAL COSTS

Chocolate, Little Chocolate, and Lynn Bayou Watershed, Texas

(Dollars)

| Evaluation Unit | : Amortization : Operation : : of : and : : Installation : Maintenance : : Cost <u>1/</u> : Cost <u>2/</u> : | Total |
|--|---|--------|
| 69.7 miles of Main and Lateral Drainage Ditches, including Appurtenances | 36,060 14,580 | 50,640 |
| TOTAL | 36,060 14,580 | 50,640 |

1/ Amortization period, 40 years; interest rate, 3-1/8 percent.

2/ Long-term prices as projected by ARS, September 1957.

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TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Chocolate, Little Chocolate, and Lynn Bayou Watershed, Texas

(Dollars) 1/

| Item | Estimated Average Annual Damage | | Damage Reduction Benefits |
|-------------------|---------------------------------|---------------|---------------------------|
| | Without Project | With Project | |
| | Project | Project | |
| Floodwater | | | |
| Crop and Pasture | 106,050 | 11,665 | 94,385 |
| Urban | 325 | 25 | 300 |
| Subtotal | 106,375 | 11,690 | 94,685 |
| Indirect | | | |
| | 10,605 | 1,166 | 9,439 |
| TOTAL | 116,980 | 12,856 | 104,124 |

1/ Price Base: Long-term prices as projected by ARS, September 1957.

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TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES
 Chocolate, Little Chocolate, and Lynn Bayou Watershed, Texas
 (Dollars)

| Evaluation Unit | AVERAGE ANNUAL BENEFITS 1/ | | | :Annual Benefit-Cost Ratio |
|--|----------------------------|--------------------------------|-------------------------|----------------------------|
| | :Flood Prevention Damage | :Agricultural Water Management | :Improved Efficiency 2/ | |
| 69.7 miles of Main and Lateral Drainage Ditches, including Appurtenances | 104,124 | 103,824 | 32,871 | 240,819 |
| GRAND TOTAL | 104,124 | 103,824 | 32,871 | 240,819 |
| | | | | 50,640 4.8:1 |

1/ Price Base: Long-term prices as projected by ARS, September 1957.

2/ Reduced cost per unit of production, increased units of production, and increased price per unit resulting from improved quality.

3/ From Table 4.

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INVESTIGATIONS AND ANALYSES

Land Use and Treatment

The status of land treatment for the project area was developed by the Calhoun-Victoria Soil Conservation District assisted by personnel from the Soil Conservation Service at Port Lavaca. Conservation needs data were compiled from existing conservation plans and expanded to represent the conservation needs of the entire project area. It was estimated that land treatment practices necessary for essential conservation treatment (table 1) could be applied during a 5-year period.

Engineering Investigations

A study and report on drainage improvements for Calhoun County Drainage District No. 11 has been made by Lockwood, Andrews, and Newnam, Inc., Victoria, Texas. This report was published in June of 1962. The report contained preliminary designs and estimated construction cost for agricultural drainage improvements.

The locations of the mains and laterals shown in this plan were determined by using the drainage surveys, contour maps, and basic engineering field survey data developed for the report. Aerial photographs were also used for this project, and additional field surveys were made to supplement available data for use in making realistic cost estimates.

All mains and laterals were designed for drainage and flood prevention.

The required capacities of the multiple-purpose channels were determined by using curves based on the formula $Q = CM^{5/6}$ where,

$$Q = \text{required ditch capacity in cubic feet per second}$$

$$C = \text{drainage coefficient}$$

$$M = \text{drainage area in square miles}$$

A value of $C = 50$ was used for the mains. The values of $C = 30$ for improved pasture and $C = 45$ for coastal area cultivated were used for design of the laterals. Drainage curves are shown on Figure 6.6, Chapter 6, Section 16 of the National Engineering Handbook.

Hydrologic and Hydraulic Investigations

The without project hydrologic conditions of the watershed were determined by considering such factors as cover conditions, land treatment, hydrologic soil groups, and crop distribution. The rainfall-runoff relationship, as represented by the condition II curve number of 82 for the hydrologic soil-cover complex, was computed for use in determining the depth of runoff from the 100-year storm event. Data from a 16 percent sample of the watershed were used in this determination.

The with project conditions were determined by analyzing the results of the land treatment that would be applied during the installation period.



This study revealed that a condition II curve number of 81 is applicable.

Lynn Bayou cross-section rating curves were developed from field survey data and by solving water surface profiles for various discharges. Computations of the water surface profiles were made by the use of the IBM 650 computer.

Runoff-peak discharge relationships for Lynn Bayou were determined by flood routing the runoff from the 6-hour rainfall, 100-year frequency, as selected from Technical Paper No. 40, U. S. Weather Bureau. The storage-indication method of routing modified by the use of a variable routing interval was used. Initial hydrographs for routing were developed by the procedure as given in Method B, Technical Letter EWP-H-1 (Revised). Flood routing with present conditions indicates that the routed storm would cause some urban damage to portions of Port Lavaca above State Highway 35-A. Routing with future conditions, the designed channel, and a lowered retardance factor indicates the 100-year flood would be below the elevation at which urban damage starts in this area. Below this point to the outfall at Lavaca Bay the stage produced by the 100-year storm would be slightly above its present elevation. However, this increase in elevation is well below any point where urban damage begins.

The main and lateral ditches were planned to follow existing natural drains except where deviations proved to be more desirable. These multiple-purpose drainage mains were designed to carry the discharge computed by the formula $Q=50M^{5/6}$ with the hydraulic gradient approximately one foot below the elevation of areas to be served by the ditches. The design was checked for flood protection to determine if the ditches would remove the runoff from a 5-year, 24-hour storm in a 48-hour period with the hydraulic gradient 0.5 foot above the elevation where damage begins. The formula for ditch capacity to meet this requirement is $Q=81M^{5/6}$. Ditches were enlarged to meet the requirement for flood protection where needed.

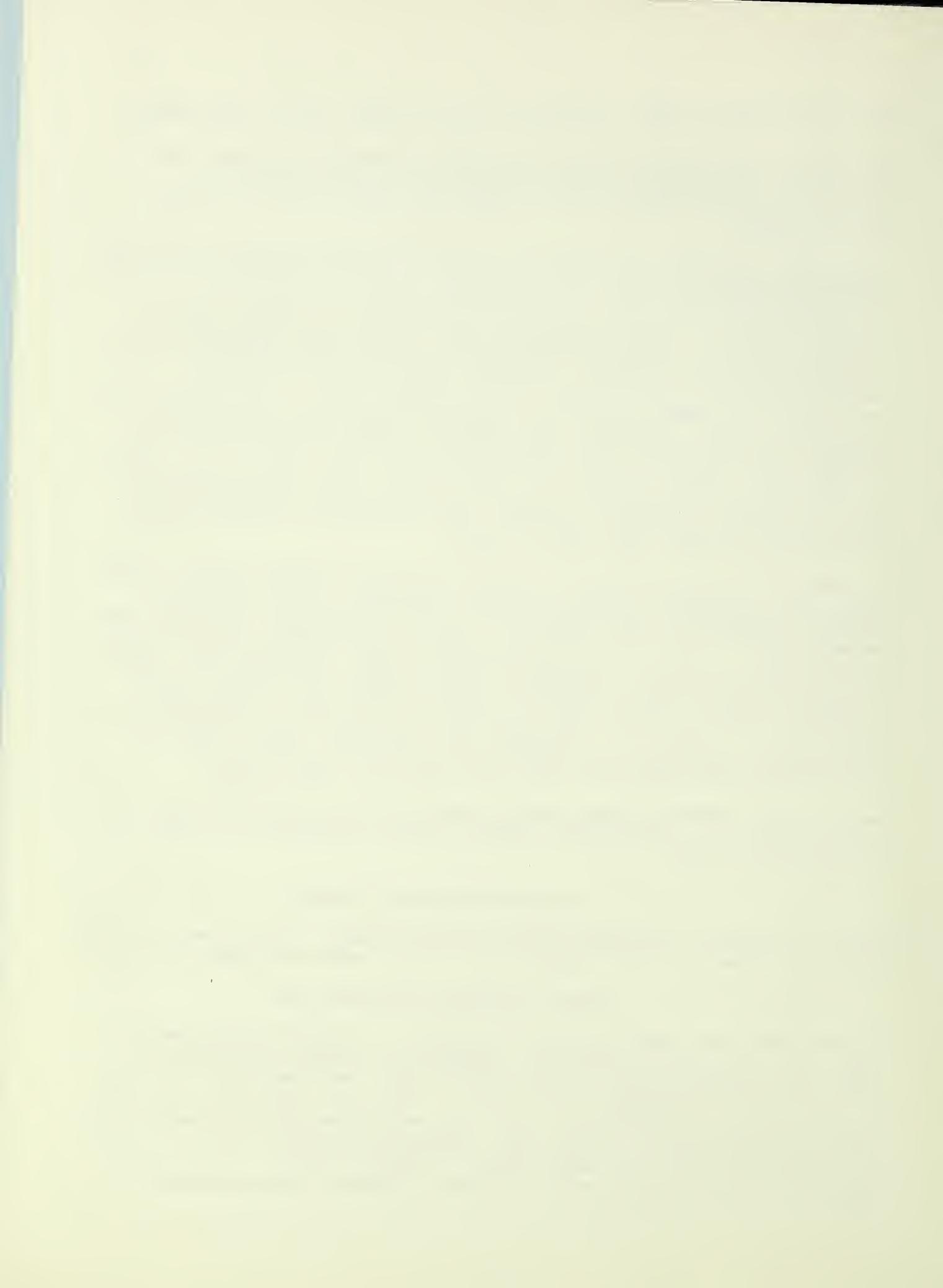
Based on the limited existing channel capacity and the proposed 5-year level of protection, the corresponding damaging runoff volume will be reduced an estimated 89 percent.

Sedimentation Investigations

Detailed sedimentation investigations were not needed. Erosion and sediment production rates are low. Sediment and erosion damages are very minor.

Channel Stability Investigations

Borings were made along the planned alignment for channel improvement to study the nature of soil materials. Mechanical analyses and tests to determine Atterberg limits, soluble salt content, and dispersion were made of two samples of representative horizons. The soils materials are clays and silty clays classified as CH and CL in accordance with the Unified Soil Classification System. Soluble salt content and dispersion are low. Based on plasticity indices, the application of critical tractive force values indicated that the channel would withstand a tractive force of 0.3 to 0.8



pounds per square foot, and a velocity of 4 to 6 feet per second. No servious stability problems are anticipated.

Economic Investigations

Evaluation of Benefits

For evaluation purposes, the project area was divided in 4 reaches (figure 2). The benefits and costs were determined for each reach. Agricultural estimates were based on information obtained from landowners and operators and from local agricultural workers.

Damage schedules were obtained in each of the evaluation reaches and covered approximately 5,500 acres of land in the drainage district.

Information was collected on present land use, crop distribution, yields, production costs, floodwater damages, and losses resulting from inadequate drainage. Estimates based on this information were compared with results obtained from drainage in adjoining districts and with the data contained in Drainage Survey Report of U. S. Study Commission - Texas.

Using current land use and experience data from farm operators and local technicians familiar with the area, the reduction in crop and pasture losses from flood damage to crops and pasture was calculated to be \$94,385. This represented an 89 percent reduction.

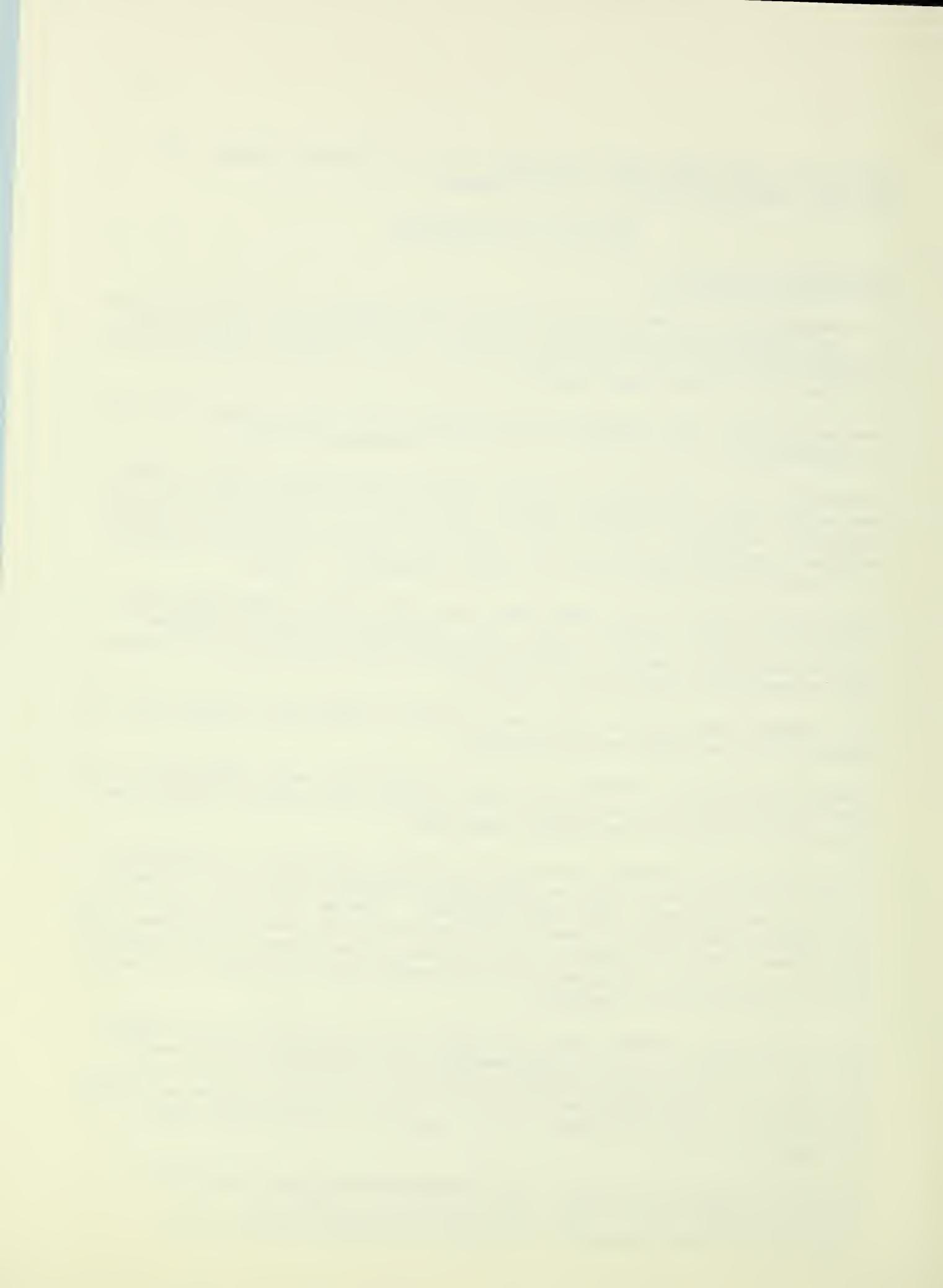
Total primary benefits for the area amounted to \$207,948, of which \$104,124, resulted from reduction of flood damage.

Primary agricultural benefits which were inseparable were calculated on the basis of increased net income that will result from improved drainage and flood prevention with the project installed.

Flood prevention benefits resulting from damage reductions to residences along Lynn Bayou were based on information obtained from city officials, real estate developers, and from homeowners. Damage estimates were related to frequency and size of floods as reflected by high water elevations. The difference between the average annual damages from storms up to a 100-year frequency after the installation of the project and that before its installation constituted the benefits.

Cost allocations between flood prevention and agricultural water management for structural works of improvement were determined by procedures outlined in the Watershed Protection Handbook, paragraph 1132.2, Alternative 2. This resulted in 50.1 of the total installation cost being allocated to flood prevention and 49.9 percent to agricultural water management.

Benefits to other than direct identifiable beneficiaries constitute about 60 percent of the total annual benefits accruing to agricultural water management. However, the Federal share of that



portion of the cost allocated to agricultural water management is limited to 50 percent. The total installation cost of structural measures for this purpose is \$407,652, of which \$203,826 will be paid by P. L. 566 funds and the same amount by other than P. L. 566 funds.

Appraisal of Land and Easement Values

Areas that will be used for project construction were determined. This area consists of a strip of land 18 feet wide on each side of and adjacent to the mains and laterals, plus the area of land taken in excavating the channels. The net income from production to be lost from these areas, plus secondary losses after project installation, was compared with the appraised value of the land. The cost of the land was determined by representatives of the sponsoring local organizations and was concurred in by the Soil Conservation Service. The value of the loss from annual production plus associated secondary losses will not exceed the amortized value of the land used for project construction, therefore the amortized value of the land was used in economic justification.

Secondary Benefits

Values of local secondary benefits and local secondary losses were calculated in accordance with the interim procedures outlined in Watersheds Memorandum SCS-57, October 3, 1962.

Secondary benefits of a local nature were considered as either (1) stemming from the project or (2) induced by the project. Benefits stemming from the project were considered to be at least 10 percent of the direct primary project benefits. Benefits induced by the project were considered to be at least 10 percent of the average annual increased production cost associated with more intensive land use.

Secondary losses resulting from installation of structural works of improvement were calculated in the same manner as secondary benefits.

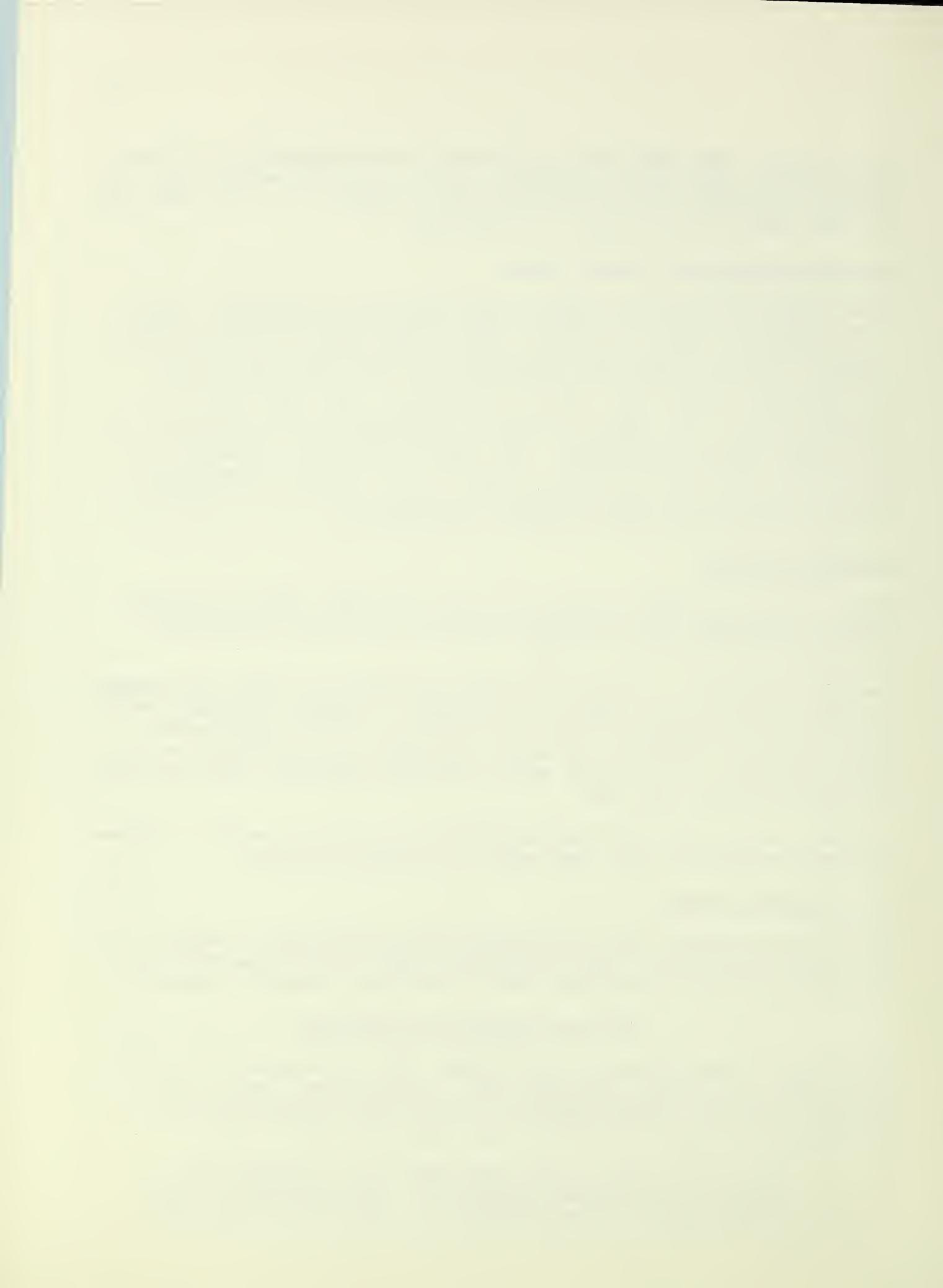
Details of Methodology

Details of the method used in the evaluations are described in Chapter 6 of the Soil Conservation Service Economics Guide for Watershed Protection and Flood Prevention dated March 1964 and Watershed Protection Handbook.

Fish and Wildlife Investigations

The Bureau of Sport Fisheries and Wildlife, USDI, in cooperation with the Texas Parks and Wildlife Department made a reconnaissance study of the proposed Chocolate, Little Chocolate, and Lynn Bayou watershed project. The following is quoted from their report dated September 1, 1964:

"All of the streams in the watersheds are intermittent and provide no significant fish habitat. The watersheds contain no farm ponds. The only wildlife of importance in the project



area are bobwhites. They are common on the upper portions of the watersheds, and there is some hunting for them. The remaining portions of the watersheds and the tidal marshes below the proposed development offer only marginal habitat for shorebirds and waterfowl. Chocolate and Lavaca Bays occasionally are used by a few wintering waterfowl.

Our reconnaissance review of the proposed project indicates that fish and wildlife resources generally will be affected insignificantly by the drainage and improvement measures contemplated. It is possible that the estuarine fish habitat in Chocolate and Lavaca Bays could be affected adversely by silt and chemical residues which may be brought into the bays by accelerated runoff of floodwaters. There are no particular measures that should be incorporated into the project work plans that would benefit fish and wildlife, and no project-associated measures are apparent that would offset possible damages.

No detailed studies by the Bureau of Sport Fisheries and Wildlife are considered necessary."

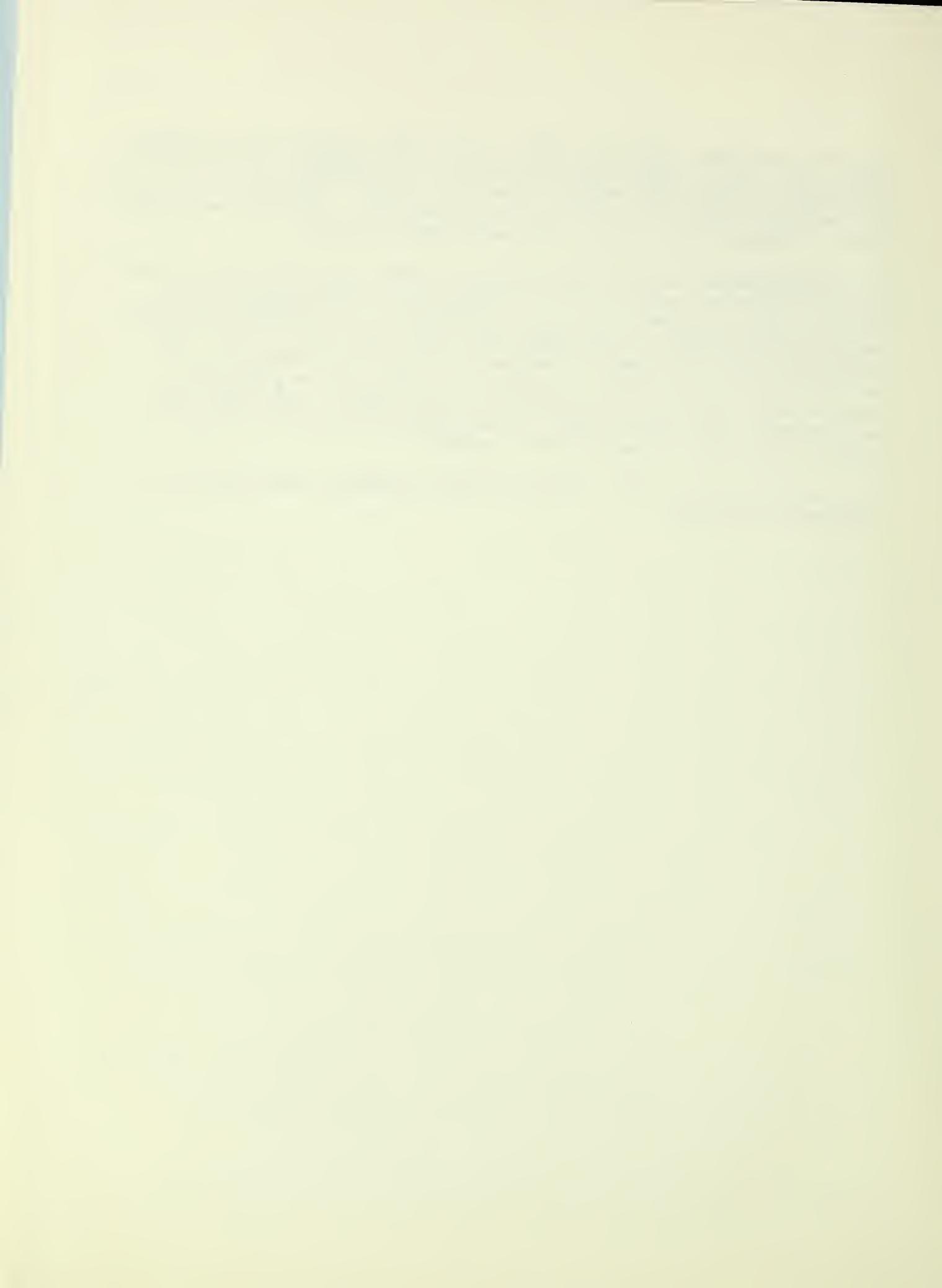


Table A - Cost Allocation and Cost Sharing

Chocolate, Little Chocolate, and Lynn Bayou Watershed, Texas
(Dollars)

Multiple-Purpose Mains, Laterals, and Appurtenances

| Item | Flood Prevention | | | Agricultural Water Management | | | Recapitulation | | |
|------------------------------------|------------------|---------|---------|-------------------------------|---------|---------|----------------|---------|---------|
| | P. L. | ; | P. L. | ; | P. L. | ; | P. L. | ; | P. L. |
| Funds | Other | Total | Funds | Other | Total | Funds | Total | Funds | Other |
| Construction | 198,202 | - | 198,202 | 160,294 | 37,118 | 197,412 | 395,614 | 358,496 | 37,118 |
| Installation Services | 43,707 | - | 43,707 | 43,532 | - | 43,532 | 87,239 | 87,239 | - |
| Administration of Contracts | - | 1,002 | 1,002 | - | 998 | 998 | 2,000 | - | 2,000 |
| Land, Easements, and Rights-of-Way | - | 166,375 | 166,375 | - | 165,710 | 165,710 | 332,085 | - | 332,085 |
| Total Installation Cost | 241,909 | 167,377 | 409,286 | 203,826 | 203,826 | 407,652 | 816,938 | 445,735 | 371,203 |
| Allocation to Purpose (Percent) | 59.1 | 40.9 | 100.0 | 50.0 | 50.0 | 100.0 | 49.9 | 100.0 | 54.6 |
| Cost-Sharing (Percent) | | | | | | | | | 45.4 |

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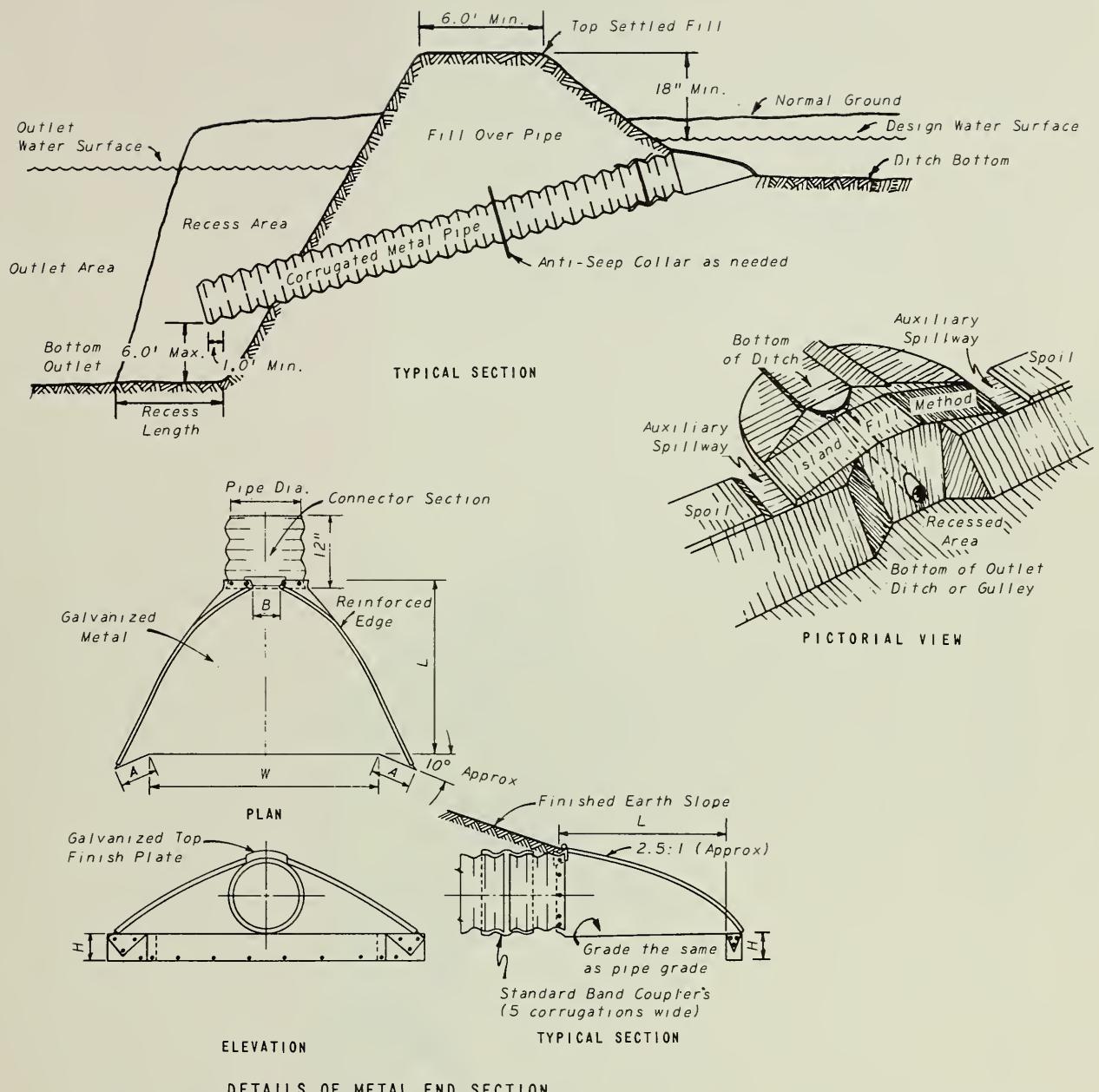


Figure 1
TYPICAL CORRUGATED METAL PIPE DROP STRUCTURE
WITH METAL END SECTION





Figure 2
PROJECT MAP
CHOCOLATE, LITTLE CHOCOLATE
AND LYNN BAYOUS
VICTORIA AND CALHOUN COUNTIES, TEXAS

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